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Volume 55
Number 11

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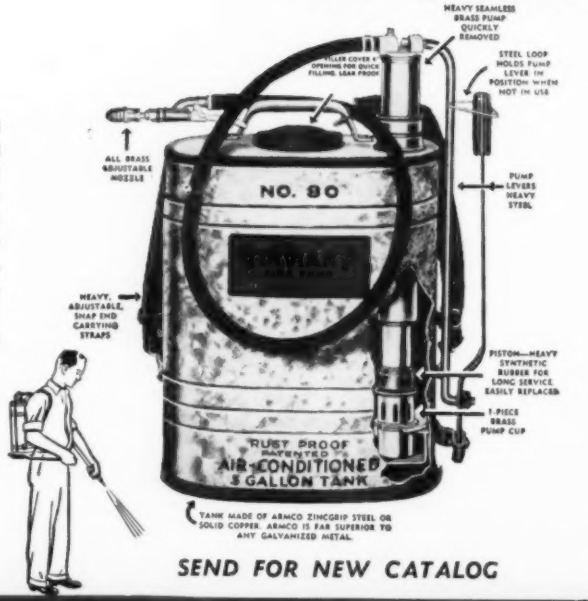
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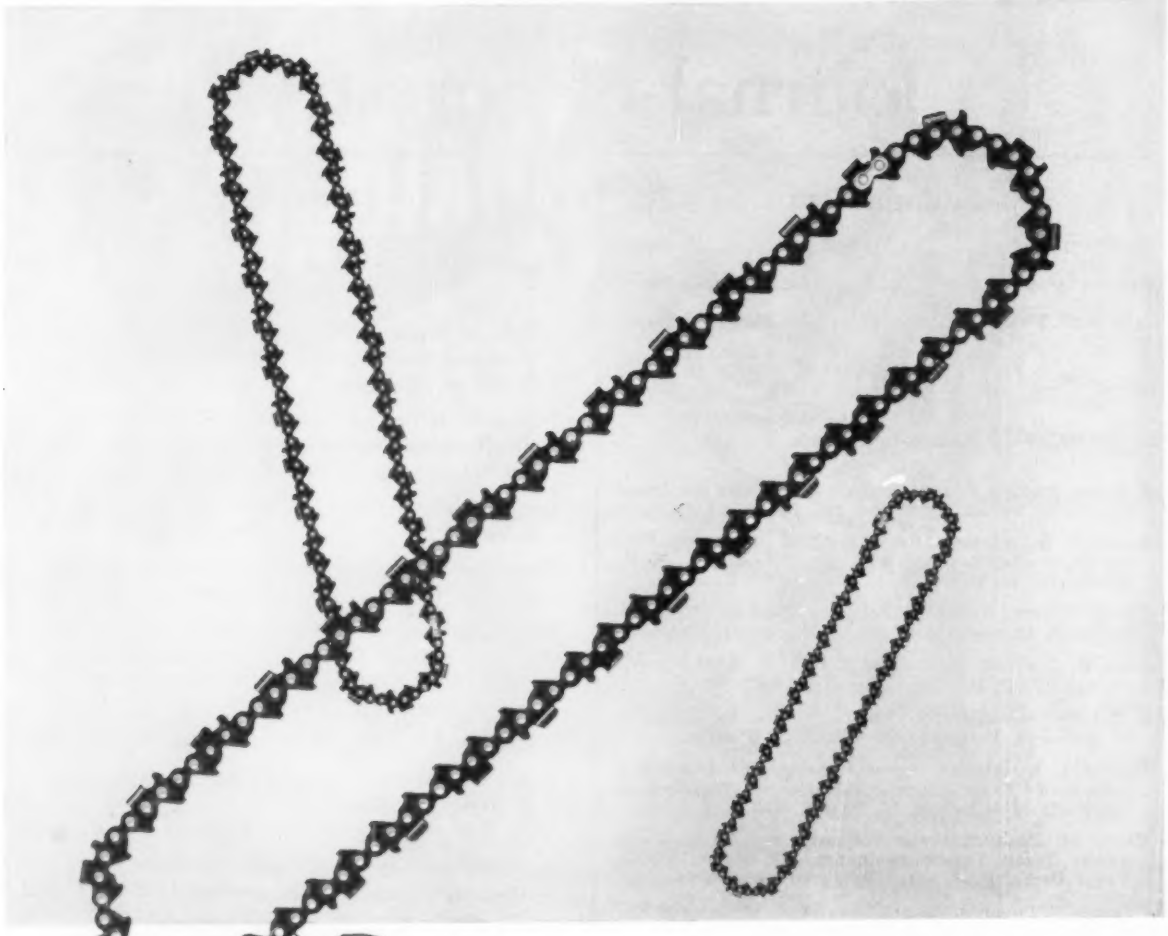

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Effects of Silvicultural Practices on Wildlife Food and Cover in Oak and Aspen Types in Northern Michigan[1]

Leslie W. Gysel
Michigan State University,
East Lansing

TIMBER stand improvement and harvest cuttings usually result in marked habitat changes for wildlife. Although the general effects of cutting have been apparent since the early days of logging and subsequent fires in northern Michigan, the ecological changes have not been intensively studied and few attempts have been made to interpret these changes in terms of wildlife food and cover. An opportunity for a study of this kind was provided by a series of experiments installed by the Lake States Forest Experiment Station at the Pine River Experimental Forest, west of Cadillac, in the Lower Michigan National Forest. Tests were made here to compare various chemical and axe methods for eliminating overstory oaks to release pine and to compare different harvest cutting practices for aspen. Resulting environmental conditions are described and measurements of plant cover and amount of browse are given.

Past History

The present oak and aspen types are on flat, sandy sites which once supported vast pine stands and a relatively small deer herd in northern Michigan. Following the cutting of the pine from 1880 to 1900, this area was burned many times. As a result of these drastic effects on the environment, hardwoods, which were originally scattered among or beneath the pines, became the dominant tree cover over extensive areas. A large deer herd developed with the increased food and cover. Following better fire control, the hardwood stands began to develop rapidly in height and density. During the late 1930's and in the 1940's, the Civilian Conservation Corps interplanted some of the open oak stands with red pine because there appeared to be no value for wood products from the hardwoods. Because of increasing competition from the hardwoods, the pine has grown slowly and browse and low cover for wildlife has became sparse. Since much of the oak type has little commercial value, inexpensive methods for controlling it to release the pine were tested. Within the last ten years aspen has become useful for pulp. Most of the experiments in the aspen stands were designed to analyze different harvest cutting methods.

Methods

Pine release experiments.—Starting in 1950, various methods for releasing pine from a hardwood overstory were tested in an area where the prevailing species, jack oak, white oak, and red oak,[2] had no commercial value. During 1955 and 1956, environmental conditions resulting from the following treatments were analyzed:

1. Girdling of trees over 4 inches d.b.h. and cutting of stems below that diameter with an axe. Treatments were made during each of the four seasons of 1950 in one-half acre plots and in a 50-acre block during the winter of 1951-52.

2. Basal spray on all tree stems with a 50-50 mixture of 2, 4, 5-T and 2, 4-D applied at a concentration of 16 pounds a.h.g.[3] Treatments were made during each of four seasons of 1950 in one-half acre plots.

3. Chemical applied in frills on trees 4 inches d.b.h. and over and on cut stems below that diameter. The chemical used was 2, 4, 5-T in diesel oil at a concentration of 4 pounds a.h.g. This treatment was made in a 50-acre block during the winter of 1951-52.

4. Aerial spray with 2, 4, 5-T at concentrations of 1 and 2 pounds of acid equivalent in 5 gallons of oil and water. The spray was applied on a 20-acre tract in August 1952.

5. Untreated check areas were examined in a stand adjacent to the area where the axe, basal spray, and frill treatments were made and in a stand adjacent to the area where the aerial spray was applied.

Bulldozing for oak sprout production.—Bulldozing was also tried in the same type of oak stand as a wildlife management technique to produce browse and additional cover. The results are reported here to compare this method with the ecological effects of stand improvement techniques. In general, only trees 5 inches d.b.h. and smaller were bulldozed because the machine available could not be used on larger sizes conveniently. A check plot was examined in an adjacent area.

Aspen cutting experiments.—Cutting methods in two separate blocks were analyzed. In one area a well-stocked merchantable stand of 10 acres was clearcut during the spring of 1952, and in the other area an 80-acre stand was commercially cut in 1949 for trees having two 8-foot bolts and again in 1955 for trees having one 8-foot bolt. A 10-acre untreated check

[1]Journal Article No. 2073 from the Michigan Agricultural Experiment Station. The writer wishes to express appreciation to the personnel of the Lower Peninsula Research Center, Lake States Forest Experiment Station, for field assistance, data, and photographs.

[2]Scientific names are listed in Table 1.

[3]A.h.g. is an abbreviation for acid equivalent per 100 gallons of spray.

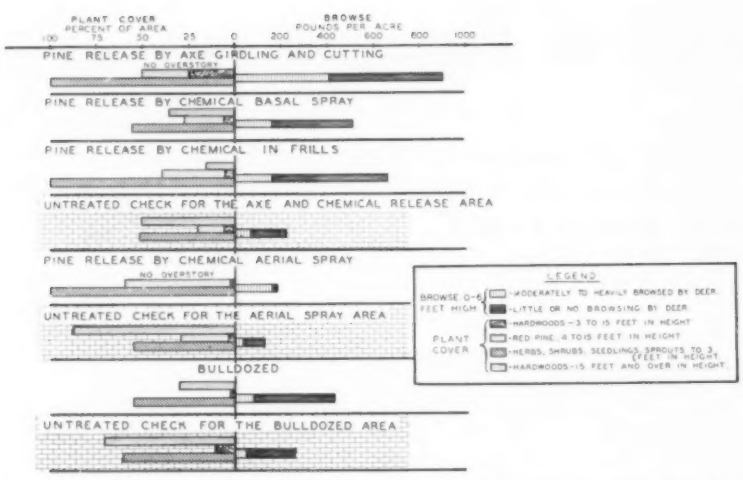
PLANT COVER
PERCENT OF AREA
100 75 50 25 0
BROWSE
POUNDS PER ACRE
200 400 600 800 1000
PINE RELEASE BY AXE GIRDLING AND CUTTING
NO OVERSTORY
PINE RELEASE BY CHEMICAL BASAL SPRAY
PINE RELEASE BY CHEMICAL IN FRILLS
UNTREATED CHECK FOR THE AXE AND CHEMICAL RELEASE AREA
PINE RELEASE BY CHEMICAL AERIAL SPRAY
NO OVERSTORY
UNTREATED CHECK FOR THE AERIAL SPRAY AREA
BULLDOZED
UNTREATED CHECK FOR THE BULLDOZED AREA
LEGEND
BROWSE 0-6 FEET HIGH
MODERATELY TO HEAVILY BROWSED BY DEER
LITTLE OR NO BROWSING BY DEER
PLANT COVER
HARDWOODS - 3 TO 15 FEET IN HEIGHT
RED PINE, 4 TO 15 FEET IN HEIGHT
HERBS, SHRUBS, SEEDLINGS, SPROUTS TO 3 FEET IN HEIGHT
HARDWOODS - 15 FEET AND OVER IN HEIGHT

FIG. 1.—Results of different methods of removing oak competition to release pine.

plot was adjacent to the clearcut area.

Bulldozing for aspen sprout production.—All the remaining trees on an acre of the commercially cut area were bulldozed after the last cut in the summer of 1955 to determine the value of this method for producing additional aspen sprouts.

Observations and Measurements

Tree cover.—The following data were taken by species in .004 acre plots: number of stems by 1-inch d.b.h. classes, height, and percent of cover by trees in two classes—6 to 15 feet in height and over 15 feet in height.

Sprouts, seedlings, shrubs, and herbs.—In .001 acre plots within the .004 acre plots the following data were taken to a height of 6 feet: percent of cover, height, and weight of leaves and stems of plants ordinarily browsed by deer clipped to approximately one-eighth inch stem diameter.

A total of 15 to 45 plot groups consisting of .004 and .001 acre plots were taken in each treated and untreated area; the number of plots varied with the size and homogeneity of the stands. In addition, stand data obtained by Lake States Forest Experiment Station personnel were also used.

Analyses of the basal spray and seasonal axe treatments were made during the summer of 1955. The axe treatment in the 50-acre block, the frill treatment, bulldozing in the oak area, and the aspen cuttings were analyzed during the summer of 1956. Additional observations were made during the winter of 1957.

Vegetation of the Untreated and Treated Oak Stands

Untreated area.—The untreated check area for the axe treatments, basal spray, and frill chemical treatments was a relatively homogeneous stand. The most common species in the overstory of the stand were jack oak, red oak, and white oak; other species were red maple, bigtooth aspen, and black cherry. Most of these oaks, which were from 3 to 6 inches in diameter and from 25 to 50 feet in height, were 20 to 30 years old; a few larger trees were 45 to 65 years old. The basal area averaged 42.7 square feet. As indicated in Figure 1 the untreated stand was partially closed; the overstory covered approximately 50 percent of the area. The ground cover and amount of browse in the summer were small although the number of plant species was relatively large (Table 1). Winter cover and browse were exceedingly sparse. Even the overtopped pine, which was from 3 to 6 feet in height, provided little cover; the number of pine varied from 500 to 900 per acre (Fig. 2). The oak stand is on a deep sandy soil classified as Rubicon sand.

Pine release by axe girdling and cutting.—Cutting and girdling proved to be an effective method for eliminating the overstory oaks. The height, diameter, and crown cover of the pines increased rapidly; after five growing seasons the average height was 13 feet. The released pine and oak sprouts, which comprised the highest vegetational strata on the treated plots, each covered approximately 25 percent of the area (Fig. 1). Most of the moderately to heavily used browse was also composed of oak sprouts which varied from 3 to 12 feet in height.

With the complete opening of the stand, the total amount of low summer ground cover greatly increased in comparison to that in the untreated stand (Fig. 1). Grasses and sweet fern, which were frequent in the untreated stands, comprised much of this cover. Low pine cover also increased; this provided most of the winter cover. Apparently the resulting competition was too great for new species to become established because only one was tallied in the cut and girdled area; in addition six species present in the untreated check area were not tallied in the treated area (Table 1).

Deer utilized the sprouts heavily, especially during the winter.[4] Seedlings, sprouts, and shrubs were also eaten by rabbits (Fig. 3).

Pine released by chemical applied by basal spray.—Many of the larger overstory oaks remained alive after treatment by basal sprays, probably a result of the relatively small amounts of chemical used. The growth of pine, amount of ground cover, and browse were less than in either the areas treated by the axe or by chemical in frills (Fig. 1). The scattered sprouts were mainly oak and aspen with some red maple and sassafras, generally 3 to 6 feet in height.

[4]According to field reports of the Game Division of the Michigan Conservation Department the deer population of the Pine River Experimental Forest area is approximately 20 to 30 per square mile.

Pine release by chemical applied in frills.—All of the crowns of the trees treated by chemicals in frills were killed; however, approximately 15 percent of the overstory cover remained because a portion of the trees in the original stand were not treated in accordance with a Forest Service policy to provide a diversification of the habitat for wildlife. Most of the frilled jack oak sprouted, but only a few of the white oak; sprouts were from 1 to 6 feet in height. The average height of the red pine after five growing seasons was 10 feet.

Herbs, shrubs, and seedlings completely covered the ground (Fig. 1). Grasses, sweet fern, and the low branches of red pine comprised most of the cover.

Moderately to heavily used browse consisted mainly of jack oak, sassafras, and bush honeysuckle; most of the lightly used browse was sweet fern.

Pine release by chemical aerial spray.—The tree composition and age of the oak stand which received the aerial spray treatment were similar to those of the oak stand previously described. The original crown cover of the sprayed stand was greater, however, and the weight of the browse before the treatment was the lowest in any of the areas observed (Fig. 1). Low cover consisted mainly of the planted red pines, scattered grasses, and sweet fern.

As a result of the chemical spray almost all of the crowns of the oaks were killed and the remaining were affected by the chemicals (Fig. 4); the middle and lower parts of these trees remained alive. Only a part of the oaks produced sprouts, which were relatively small in diameter and height. All sprout clumps were browsed by deer and most clumps originating from the larger trees were partly or completely dead, apparently as the result of poor vigor and browsing. With the decreased competition the red pine increased markedly in height, diameter, and amount of cover. Portions of the stand had almost closed four seasons after the spray application; however, irregularities due to variations in planting and survival provided many scattered openings.

Grasses were the dominant ground cover. Other species such as blueberry, sweet fern, bracken fern, and tree seedlings were scattered throughout the area (Table 1).

TABLE 1.—FREQUENCY[1] OF PLANT SPECIES 0 TO 6 FEET IN HEIGHT IN THE OAK AND ASPEN AREAS

Species[2]	Oak area				Aspen area	
	Untreated check	Axe girdle and cut	Chemical in frills	Chemical by aerial spray	Untreated check	Clear-cut
	Frequency—Percent					
MODERATELY TO HEAVILY BROWSED						
Jack oak (*Quercus ellipsoidalis*)	42	61	56	42		
Red oak (*Q. rubra*)	13	14		25	40	50
White oak (*Q. alba*)	15	25	16	8	60	
Bigtooth aspen (*Populus grandidentata*)	2	7			5	100
Red maple (*Acer rubrum*)	21	14	5	25	95	83
White ash (*Fraxinus americana*)						66
Black cherry (*Prunus serotina*)	6	39	27	42	60	42
Hawthorn (*Crataegus spp.*)		7	11		10	
Sassafras (*Sassafras albidum*)	8	2	5		65	8
Juneberry (*Amelanchier spp.*)	17	27	11	16	35	8
Dwarf sumac (*Rhus copallina*)						16
Bush-honeysuckle (*Diervilla lonicera*)	26	22	22	8	75	25
Rose (*Rosa* spp.)	2		8			
Low sweet blueberry (*Vaccinium angustifolium*)	42	45	33	100		
Maple-leaved viburnum (*Viburnum acerifolium*)	6		5		25	
LIGHTLY BROWSED OR NOT BROWSED						
Red pine (*Pinus resinosa*)	79	77	44	75		
Choke-cherry (*Prunus virginiana*)	2				5	
Willow (*Salix* spp.)	4		5	8		
Dewberry (*Rubus flagellaris*)	8	4	22			
Blackberry (*Rubus alleghenicnsis*)	4	32	22	8	100	100
Sweet-fern (*Comptonia peregrina*)	91	91	100	83		
Bracken fern (*Pteridium aquilinum*)	30	61	5	58	80	100
Witch hazel (*Hamamelis virginiana*)					10	
Teaberry (*Gaultheria procumbens*)	2			50	45	
Strawberry (*Fragcria* spp.)	6	11			10	
Rattlesnake-root (*Prenathes* spp.)						
Common lousewort (*Pedicularis canadcnis*)					5	
Aster (*Aster* spp.)			11		45	33
Dogbane (*Apocynum androsaemifolium*)	2	2	38	8	20	
False spikenard (*Smilacina racemosa*)	13		5		20	
Goldenrod (*Solidago* spp.)	4		33			
False lily-of-the-valley (*Mainanthemum canadense*)					5	
Grasses in the oak area include the following: *Danthonia spicata, Deschampsia flexuosa, Panicum lanuginosum* var. *fasiculatum, Poa pratensis;* in the aspen area: *Panicum linearifolium Panicum latifolium, Danthonia spicata, Poa compressa*	98	98	100	100	100	100

[1]Frequency is a measure of the distribution of the plants. It is expressed by the percentage of sample plots in which the species occurs.

[2]Common and scientific names are according to Fernald, M. L. Gray's Manual of Botany, 8th Ed. American Book Co. New York. 1950.

Bulldozing for browse production.—After bulldozing, some of the trees were completely broken off near the ground level, some were partly broken, and some were completely uprooted. Two growing seasons after the treatment, about one-half of the bulldozed stems remained alive with green leaves and stems in the original crowns. Scattered stem sprouts and stump sprouts from 1 to 3 feet in height were generally browsed. The branches and leaves from the crowns of the bulldozed trees added

FIG. 2.—An untreated stand of jack oak, red oak, and white oak overtopping red pine which was planted in 1940. Note the lack of low cover other than the pine and absence of browse. The picture was taken in the winter, 1957.

FIG. 3.—Jack oaks and white oaks cut and girdled to release red pine. Four growing seasons after the release operation the overstory oaks are dead and the pine in the background has increased in height and crown surface. The upper parts of the red maple and oak sprouts in the small opening were browsed by deer and the lower parts were eaten by rabbits. Blackberry stems were also eaten by rabbits.

FIG. 4.—Jack oak killed by chemical aerial spray. This picture was taken in August, one year after the spray treatment. Sprouts are few and the dense ground cover consists mainly of grasses, bracken fern, blueberry, sweet fern, and tree seedlings.

to the depth of the ground cover but were lightly browsed. The total amount of preferred browse was relatively small (Fig. 1).

Vegetation of the Untreated and Treated Aspen Stands

Untreated area.—The untreated check area was a dense 40-year-old stand in which most of the trees were 50 to 65 feet in height. Bigtooth aspen was the predominant tree species; diameters of the overstory trees varied from 4 to 11 inches d.b.h. Other tree species in the stand were red maple, red oak, white oak, and sassafras. The basal area was 112 square feet per acre and the volume to a 4-inch diameter, 36.5 cords per acre. Cover from the tree crowns in the overstory was generally complete, but tall shrubs and saplings in the understory were sparse (Fig. 5).

Even though there were a large number of trees per acre, a relatively large amount of light reached the ground and a moderately dense summer ground cover composed of 25 species existed throughout the stand (Table 1). Winter cover, however, was very sparse and most of the browse was untouched during the winter.

The soil of part of the area was classified as Rubicon sand; part was Montcalm loamy sand.

Clearcutting for pulp.—After the clearcutting of an aspen stand, many root suckers generally develop from the roots of each cut tree (Fig. 6). In 1956, four years after the cut, there were approximately 6,500 bigtooth aspen sprouts and 3,700 sprouts and seedlings of red maple, red oak, black cherry, and white ash, which provided a large amount of browse (Fig. 5).

In addition to a large number of sprouts and seedlings which comprised about one-third of the dense summer ground cover, bracken fern, blackberry, and grasses were also common species (Table 1). Dead fern and berry stems intermixed with dead tree limbs and live aspen stems provided many spots of dense low cover during the winter throughout the stand; only leafless stems of the aspen sprouts provided taller cover.

Browsing on individual aspen stems was relatively light. Of the tree species, only white ash was browsed consistently enough to keep the main stems low; dwarf sumac was also consistently browsed.

Commercial cutting for pulpwood.—As a result of two commercial cuts in this stand, all of the larger aspen were removed. After the cutting, an overstory of 330 noncommercial trees 3 to 5 inches in diameter was left, the crowns of which covered approximately 40 percent of the ground area (Fig. 5). The number of aspen sprouts was about half that of the clearcut area and the total amount of browse slightly more than half (Fig. 5). As in the clearcut area, deer browsing on individual aspen stems was light; other species were more heavily browsed.

Herbs, shrubs, seedlings, and sprouts formed a continuous dense ground cover in which aspen, bracken fern, and grasses were the most numerous species.

Commercial cutting and bulldozing.—With the removal of the remaining trees in the commercially cut stand by bulldozing, the main change in the stand as compared to the commercial cut was a relatively small increase in the number of aspen suckers, a large increase in the number of leaves and branches on older sprouts, and an increase in the total weight of the aspen browse (Fig. 5). Other browse species made up a minor proportion of the total amount of browse. Observations and measurements were made during the first growing season after the bulldozing treatment, and therefore the response to the additional opening of the stand was not complete. More sprouts and browse will probably develop as a result of the bulldozing treatment after another growing season or two.

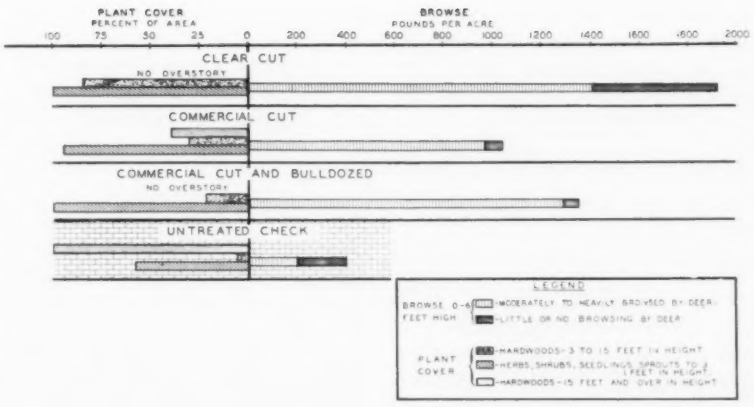
PLANT COVER
PERCENT OF AREA
100 75 50 25 0
BROWSE
POUNDS PER ACRE
0 200 400 600 800 1000 1200 1400 1600 1800 2000
CLEAR CUT
NO OVERSTORY
COMMERCIAL CUT
COMMERCIAL CUT AND BULLDOZED
NO OVERSTORY
UNTREATED CHECK
LEGEND
BROWSE 0-6 FEET HIGH
MODERATELY TO HEAVILY BROWSED BY DEER
LITTLE OR NO BROWSING BY DEER
PLANT COVER
HARDWOODS-3 TO 15 FEET IN HEIGHT
HERBS, SHRUBS, SEEDLINGS, SPROUTS TO 3 FEET IN HEIGHT
HARDWOODS-15 FEET AND OVER IN HEIGHT

FIG. 5.—Results of cutting aspen for pulp.

FIG. 6.—Aspen sprouts were predominant in the clearcut area one year after the removal of the overstory trees. Three years later this stand produced 1,900 pounds of browse per acre.

Discussion

In Michigan as in other northern states, animal populations, especially the game animals, are important assets or products of forested land. Various kinds of silvicultural practices affect the habitat of these animals and therefore these practices may be important aspects of game management. In northern Michigan the supply of suitable browse

for white-tailed deer becomes less each year in many areas as the stands which originated after the early logging and fires become older and more completely closed. Rabbit cover and varied habitat conditions for ruffed grouse may also become less in these closing stands.

In a large proportion of the extensive oak stands of the northern part of Michigan, which are from 20 to 65 years old, the overstory is the main cover. Browse species are sparse, and plants which form summer and winter cover are scattered. Since the oak has little commercial value at the present time, most of the stands remain uncut. However, in the stands in which red pine was interplanted, a practical silvicultural procedure is to remove the overstory oak to release the pine. Of the various methods tested for releasing the pine, all were successful in making a complete release with the exception of the basal spray treatment. As a result of the removal of the overstory, herbs, shrubs, seedlings, and sprouts generally formed a continuous dense cover. The greatest increase in browse resulted from the axe treatment which greatly stimulated the growth of sprouts. In none of the areas examined, however, were the sprouts over-topping the pine. This was partly due to the fast growth of the pine after its release from the oak overstory and partly due to the browsing of sprouts by deer. The amount of preferred browse resulting from the different chemical treatments was about half that of the axe-treated plots. Apparently the action of the chemicals on the trees reduced sprouting vigor so that the number and height of the sprouts was much less than that resulting from the axe treatment.

The mixture of pine, hardwood sprouts, herbs, and shrubs that follow the release operations make what appears to be an ideal habitat for deer, rabbits, and grouse. The pines provide both summer and winter cover that could be utilized by both large and small animals. The different browse and berry producing plants provide a varied animal diet, and the low cover is added protection for rabbits and grouse.

The removal of large oaks decreased the amount of acorns which are food for deer, grouse, squirrels, and other animals. Over large areas the complete removal of oaks and the subsequent growth of the pine would probably lower the carrying capacity of an area for some of these animals. However, complete removal would seldom be the case because of incomplete girdling or incomplete chemical action on the larger trees and because of sprouting which occurred with all of the methods. In addition, it is standard Forest Service policy to leave a specified number of oaks per acre. Provisions for such practices are outlined by Duvendeck[5] and Arend and Coulter.[6]

In areas where the pine had been released by cutting and girdling 14 years ago, low oak sprouts, shrubs, and pole size oak trees were scattered throughout the stands. Approximately 130 pounds per acre of moderately to heavily used browse, about double the amount in the untreated oak areas, was available. The pine stands were partly closed and cover for small animals and deer was relatively dense. Even after the pines become dominant tall trees, the oaks and scattered stems of aspen, red maple, and black cherry will be in the stands. However, the carrying capacity of the stands for most game animals will probably be lower because of a decrease of available food. Perhaps at this stage of stand development the main value of the pine as a component of the game range will be the diversity of cover within the large areas of pure hardwoods.

At first glance, dense uncut aspen stands in the Pine River area appeared to have little variety in the overstory and in the understory. An analysis of the stands, however, indicated various species in the overstory and a relatively large variety of plants in the understory; many were preferred deer browse species but were lightly utilized, probably because of the lack of cover, especially in the winter.

Aspen stands which will produce a quantity of pulpwood to meet commercial requirements are ordinarily harvested in northern Michigan. The cutting is usually heavy although a commercial cut may not be a clearcut because of small nonmerchantable trees in the stands. However, according to recommended silvicultural practices,[7] clearcutting is the best practice to obtain adequate aspen reproduction. In the clearcut stand of this study aspen reproduction covered the area. These aspen root suckers and sprouts of other trees provided a large amount of browse, two to four times that resulting from the removal of oak. After the commercial cut in which the smaller trees were left standing, the number of sprouts and amount of browse was about half that of the clearcut area.

In all the experimental areas the stand structures after the treatments were greatly different from those of the untreated check areas. It is interesting to note, however, that there was little difference in plant species composition.

Summary and Conclusions

Ecological effects of different methods for releasing red pine from overstory oaks and harvest cutting practices in aspen in northern Michigan were analyzed and evaluated in terms of wildlife food and cover.

In the release studies the overstory oak was treated by axe girdling and cutting, chemical basal sprays, chemical in frills, and chemical applied as an aerial spray. All or most of the oak was removed by the use of these methods. Four to five years after the release, the height growth and crown diameter of pine was approximately double that of the pine in the untreated stands. Also as a result of the opening of the stands

[5]Duvendeck, J. P. A basic formula for managing oak for game. Mich. Dept. of Conservation, Game Division Report No. 2088 (mimeog.) 1956.

[6]Arend, J. L., and L. L. Coulter. Aerial applications of herbicides. Down to Earth 12 (1):18 20. 1955.

[7]Society of American Foresters. Recommended forest practices for the principal forest types of Lower Michigan. Prepared by the Forest Practices Committee, Lower Michigan Chapter, 25 pp. (mimeog.) 1955.

the number of stems and leaf surface of herbs, shrubs, seedlings, and sprouts greatly increased. Sprouts resulting from axe girdling and cutting were taller and more numerous and the total amount of browse was greater than in the plots treated by chemicals. The mixture of pine cover, various plant species suitable for browse, and dense low summer plant cover, including berry-producing plants, provided a diversification of vegetative conditions in the oak type which apparently improved the range for deer, grouse, rabbits, and many non-game animals. Winter use of the various areas by deer was generally proportional to the amount of pine cover, and rabbit use was greatest where low ground cover was dense.

The mixture of pine, low deciduous cover, and browse species will remain in some release areas for at least 10 to 15 years. When the pines become tall dominants, the main value of the released stands as a part of the range of game species may be in the diversity of cover within large areas of pure hardwoods.

The dominant cover after the cutting of aspen was composed mainly of aspen root suckers which provided a large number of stems for a future stand and for deer browse. These sprouts plus those of other species provided two or more times the weight of browse produced as a result of treatments in the oak stands. The number of sprouts was much greater in the clearcut stand than in the commercially cut area.

Only a small amount of preferred browse and scattered low cover resulted from the bulldozing of an oak stand. From a similar operation in aspen a marked increase in the number of leaves and branches of aspen sprouts occurred one year after bulldozing.

Plant species composition was approximately the same in treated and untreated stands in both the oak and aspen types.

The utilization of tree seedlings, sprouts, and shrubs by deer and rabbits in the oak and aspen areas in no way interfered with the silvicultural objectives. Actually, browsing by deer and the eating of twigs by rabbits in the release areas were beneficial in keeping the sprouts low. In the cut aspen stands browsing may aid in thinning the dense sprout growth.

Two Forest Service Men Awarded Fire Medals

For acts performed on forest fires above and beyond the call of duty, Chester D. Cannon, Jr., of Alturas, Calif., and Joseph D. Kobus, Carmel Valley, Calif., were awarded American Forest Fire Medals—forestry's "Congressional Medal of Honor." During the past 20 years only 11 medals had been presented, four of them posthumously.

R. E. McArdle, chief of the U. S. Forest Service, presented the medals to these two Forest Service employees for the American Forest Fire Foundation at The American Forestry Association's annual banquet at Madison, Wisc., on October 1.

Mr. Cannon was cited for heroic action and the display of unusual courage, competence, leadership, and fire fighting skill in saving the lives of 59 men on the McKinley fire in California, September 22, 1956.

Mr. Kobus was honored for outstanding performance and heroic action on the Thompson Peak fire, also in California, on September 6, 1955. He voluntarily joined four inexperienced firefighters that were about to be trapped by a major breakthrough and by his efforts was responsible for their survival without injury.

Design for a Test of Commercial Thinning On the Hemlock Experimental Forest[1] In Western Washington

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COMMERCIAL THINNING is the first type of thinning extensively practiced as forestry is introduced into a forest region. A program of applied forest research must include tests of commercial thinning, often before adequate silvicultural information is available. As a result, research is faced with the problem of setting up an experiment to test economic and silvicultural aspects of the operation simultaneously. An experiment that will yield this information and still stand scientific scrutiny is not easily designed.

This paper describes the layout for one such experiment in western hemlock stands. Ramifications of design and requirements from a statistical standpoint as applied to this problem are not treated in detail. Rather, the experiment and some of the thinking behind it are presented as a possible source of ideas for others faced with the problem of establishing similar studies.

Definition of Commercial Thinning

A thinning in which value of products removed will at least equal direct cost of extraction is usually considered a commercial thinning. In experimental tests one object is to *find out* whether the value of products removed will equal cost of extraction. Hence definition for research purposes might be revised: Commercial thinning is a thinning in which salable products are removed, the value of which is expected to approximately equal or exceed direct costs of extraction. This is the definition used by the Puget Sound Research Center for tests of commercial thinning.[2]

Requirements for an Experiment to Test Commercial Thinning

As already intimated commercial thinning experiments are usually designed to obtain two distinct kinds of information: (1) costs (expressed both as time and money) and returns, and (2) silvicultural data as a measure of immediate and long range effect of thinning on the stand.

Reliable cost and return data can only be obtained from a sizable operation. The reasons are:

1. Some inefficiency is inevitable at the beginning while the operator gains experience. The thinned area must be large enough that the "experience-gaining" phase is only a small portion of the total.

2. Certain fixed costs, which are incurred as in any logging operation, should be distributed over a large enough volume to keep them from being unrealistically large per unit volume.

3. Frequently, marketing limitations dictate a certain minimum volume per operation.

In addition, commercial thinnings conducted primarily for research are usually expected to have substantial demonstration value. For this purpose, pilot plant size operations are most useful.

Silvicultural information, on the other hand, is best obtained from small, homogeneous areas on which thinning may be closely controlled and careful measurements made. Since such measurements can be made on only a fraction of the larger area commercially thinned, they are necessarily confined to sample plots within this area. Although plots might be carefully selected for homogeneity, it is desirable that they be representative of the whole area from which cost and other data are collected. For that reason, they should be mechanically or randomly located to insure a true cross section. As an inevitable result of mechanical or random selection, however, the plots will not be homogeneous and will frequently span a broad range of stand conditions and thinning intensities.

The apparent compromise in design required for collection of both kinds of data does have some offsetting advantages. Small sample plots, for example, may be used as individual observations permitting regression analysis of relation of growth to beginning growing stock or growth to specific cutting made on different plots. In a randomized block of experiment, individual sample plots may further be used as observations for covariance analysis, frequently yielding more useful information and providing a more sensitive test than analysis of variance alone.

When blocks large enough for collection of cost information and stands old enough to support commercial thinning are both provided for, it is virtually impossible to

[1] Maintained jointly by the St. Regis Paper Company and the Pacific Northwest Forest and Range Experiment Station, in the Grays Harbor area of western Washington. The Puget Sound Research Center, a branch of the Experiment Station, has primary responsibility for conduct of experiments on the forest.

[2] Hawley and Smith define commercial thinning as thinning in which the felled trees are converted to useful products, regardless of whether or not their value is great enough to defray the costs of the operation. (The Practice of Silviculture, 6th ed., 1954, p. 405). The definition used in this paper is intended to localize application of commercial thinning. Thus, removal of mine timbers from a western Washington forest would be classed as a commercial thinning by Hawley and Smith's definition, but not by the one used here since mine timbers cannot be marketed in the area.

exercise strict control over thinning. Rigid spacing cannot be achieved. Character of beginning stand can be only very roughly controlled; hence size, crown class, and quality of trees left after thinning will vary widely from one sample plot to another. To specify a thinning and measure the results with the accuracy recommended by Barrett and Righter (*1*) or Osborne (*2*) therefore becomes impractical. Instead, commercial thinning experiments are more nearly large-scale silvicultural tests of the type thoroughly discussed by Ostrom and Heiberg (*3*). Treatments in a commerical thinning test, however, may be more closely defined and results measured with more precision than, for example, a test of regeneration cuts involving group selection. For this reason, a commercial thinning experiment can be designed that lends itself to statistical treatment better than the tests envisioned by Ostrom and Heiberg. The author recognizes, of course, that the large areas necessary for commercial thinning usually preclude installation of enough replications for a sensitive test of results.

A commercial thinning experiment may involve only testing no thinning versus thinning, in which the thinning treatment is simply the best type of thinning known. More commonly, several types of thinning are tested, involving variables such as frequency of cutting, thinning method, volume removed, or volume left.

Economic results should be obtained from careful cost records based on time spent by jobs, and volume and sale value of material removed. The entire area thinned by a given treatment becomes the observational unit. Keeping the records in terms of time and volume makes it possible to apply results to similar operations with different hourly rates and product values. Cash margin can also be expressed in terms of labor return where appropriate.

Immediate silvicultural effects are usually measured in terms of periodic volume growth and long-term results in terms of volume yield over the entire rotation. Secondary effects such as damage to residual stand, mortality (aside from its effect on net growth), and response to release (in terms of diameter growth) are often measured too, even though such factors are eventually reflected in growth and yield.

The Hemlock Experimental Forest Commercial Thinning Experiment

On the Hemlock Experimental Forest commercial thinning is being tested in a nearly pure, well-stocked, western hemlock stand that originated in 1903. First thinnings were made in 1952 when the stand was 49 years old. Though predominantly even-aged, many scattered trees were left when the original old-growth stand was logged. Some of these trees were part of the main canopy and others suppressed understory trees. Today these trees are mostly large, of poor quality, and often badly infested with mistletoe. In contrast, trees in the main young-growth stand are good quality and average about 13 inches in diameter and 100 feet tall (Fig. 1).

Blocks and Treatments.—With most of the requirements just described in mind, the commercial thinning experiment was laid out and designed as a randomized block experiment with five treatments. By 1956, one replication had been thinned, a second had been laid out, and one or two others planned (Fig. 2). Layout and thinning of the third and fourth replications can be accomplished only as an adequate road system is developed on the forest.

FIG. 1—Edge and interior views of the 49-year-old western hemlock stand thinned in the commercial thinning experiment.

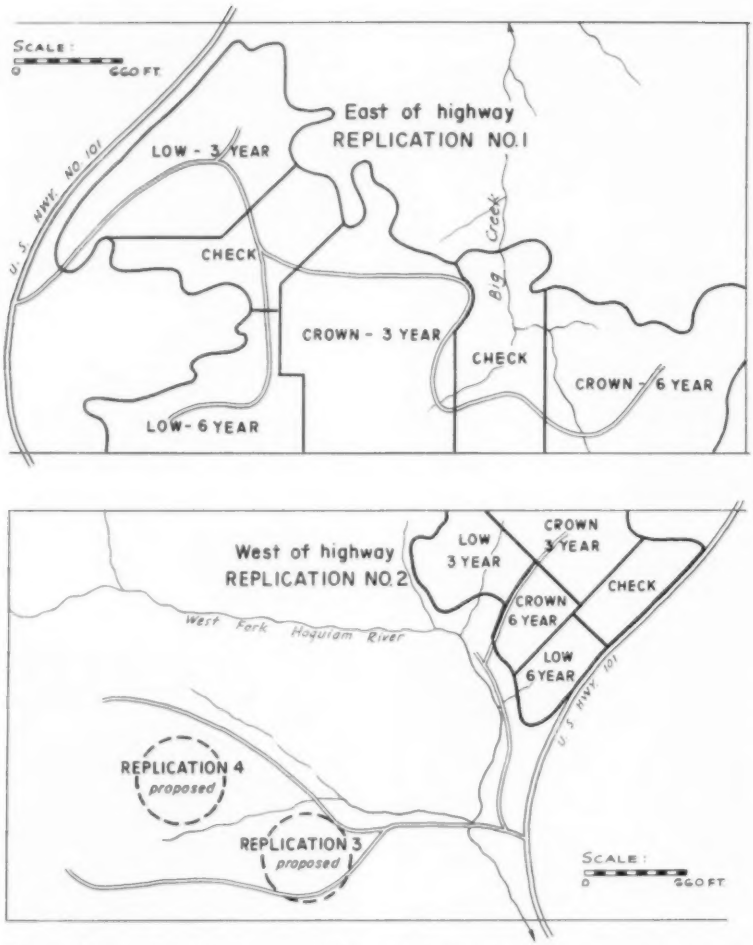

FIG. 2—Map of Hemlock Experimental Forest showing layout of two replications of commercial thinning experiment and proposed locations of two additional replications.

In the first replication, compartments each cover from about 15 to 25 acres. In the second replication, which is located in a more restricted type area, compartments cover about 6 acres.

Treatments applied at random include: (1) crown thinning at 3-year intervals, (2) crown thinning at 6-year intervals, (3) low thinning at 3-year intervals, (4) low thinning at 6-year intervals, and (5) no thinning. In the first replication a no-thinning area was established for the crown thinning treatments and another for the low thinning. The two together are somewhat larger than any of the thinned compartments.

Volume removed in each thinning roughly equals 85 percent of the gross cubic-foot increment for the 3- or 6-year period.

Crown and low thinnings are not rigidly defined, except that in the low thinning, average diameter of the trees cut is at least 3 inches less than the stand average before thinning, and in the crown thinning 3 inches greater. A few small trees may be cut in crown thinning, a few large ones in low thinning, as long as the average still meets these specifications. Since this is commercial thinning, there is a certain minimum-sized tree that may be marked. Average d.b.h. of the stand before thinning is therefore based on trees larger than the minimum.

Selection of treatments tested is quite arbitrary in view of the many variables that might affect success of commercial thinning. Treatments chosen are presumed to be important in this stand either from an economic or silvicultural standpoint.

The 6-year cut removes, roughly, twice as much volume as the 3-year cut. Differences may be reflected in economies of the operation in two ways: (1) heavier cuts may be more profitable, largely because certain fixed costs may be spread over a larger volume; (2) thinning every three years may salvage a higher percentage of mortality, thus increasing yield. From a silvicultural standpoint, light cuts would be expected to affect the stand differently than heavy cuts, though thinnings planned for this experiment are probably not extreme enough to show any differences.

Larger trees are removed in crown thinning than in low thinning. This is expected to influence cost of logging markedly, since skidding and loading costs, particularly, vary so greatly with tree size. Equipment used, however, can and does alter expected effects. Silviculturally, the more radical opening of the stand in a crown thinning may adversely affect the remaining stand by inducing windthrow or reducing growth. Skidding large trees may also cause more logging damage.

Sample plots.—From 16 to 25 sample plots are mechanically spaced in each compartment in the first replication. In the second replication each compartment, including the check, has 10 plots. Spacing plots mechanically greatly facilitates their installation. Centers are conspicuously marked and, since plots are spaced approximately 2 chains by 2 chains, the plot lines serve as strip boundaries for marking, speeding up that operation. These reasons are considered ample justification for mechanical rather than strictly random location.

Circular 1/40-acre and 1/10-acre plots with a common center are used. All trees larger than 1.5 inches d.b.h. are tallied on the 1/40-acre plot. On that part of the 1/10-acre plot outside the 1/40-acre, only trees larger than 5.5 inches are tallied.

Keeping the tallies separate permits easy separation of ingrowth, even on untagged plots. On the small plots (neglecting ingrowth to the 2-inch class) any decrease in number of live trees less than 5.5 inches must be accounted for by increase in number of larger trees —ingrowth to the 6-inch class. On the larger plot any increase in number of live trees must likewise be due to ingrowth to the 6-inch class. Ingrowth will be rare in this stand as trees less than 5.5 inches are mostly understory or very slow-growing. Where it does occur, plot growth may be estimated by calculating growth separately for the smaller than 5.5 inches and larger than 5.5 inches stand segments. That is, growth on trees less than 5.5 inches at the beginning of the period would be computed for the 1/40-acre even if some of the trees grew into the 6-inch class during the period. On the larger plot only growth on trees larger than 5.5 inches at the beginning of the period would be counted, even if there had been an increase in the number during the period. The growth figures, adjusted to a common base, may then be added together for an estimate of total growth. It is apparent that this may not equal exactly the difference between successive inventories, which account for ingrowth in a different manner.

An isolation strip which extends 100 feet beyond plot boundaries is maintained when edge of compartment coincides with a timber edge. Where compartment boundaries are between different thinning treatments in the same forest type, or where adjacent forest type is not greatly different, a 50-foot isolation strip is maintained.

Trees on 10 plots in each compartment are tagged and their diameters recorded to the nearest 1/10-inch at each measurement. On remaining plots, trees are marked at breast height with a bark scribe and diameters recorded in 1-inch classes. All plots may be used for growth and yield calculations. In addition, diameter growth data may be derived from the tagged trees.

Logging damage is recorded for trees on tagged plots for possible future use in decay studies. Damage done at each logging is recorded as root (R), basal damage below breast height (B), trunk damage to bole above breast height (T), crown (C), or (L), for leaning trees. Root damage is recorded in number of major roots exposed and injured, basal and trunk damage as tenths of the tree's circumference barked, and crown damage as tenths of crown destroyed.

Local volume tables. Local volume tables for computing cubic and board-foot volumes are made up from standard volume tables using mathematically fitted height over diameter curves (*4*). Trees to be measured for height are selected at random from tagged-tree plots using a scheme that will insure the desired distribution over the diameter range. Twenty-five trees per treatment are used for the height curve, which is to be recalculated every 6 years.

Experience with the Design

Experience during the first four years indicates no serious shortcomings in experimental design. Compartments designated for thinning in the first replication have all been thinned once and those to be thinned at 3-year intervals have been thinned twice.

Considerable variation was found in original stands in the various compartments as was expected. Although these differences undoubtedly influence costs and returns of the thinning operation, their effect so far has been outweighed by differences in operators and equipment.

Because of initial variation among compartments, simple growth comparisons following thinning are not very meaningful. Specifically, it is impossible to tell whether the difference in growth between thinned and unthinned compartments was due to thinning or to lesser original volume in the thinned compartments. More detailed analysis using growth measured on individual plots as observations is expected to make more precise comparisons possible. At the same time it is evident that many more replications than are possible on the Hemlock Experimental Forest would be needed to make the experiment highly sensitive. In one sense, we are looking only for gross differences. If two kinds of thinnings, for example, differ by only 10 percent in one measure or another, the difference is unimportant, and both kinds may be said to be successful. If one kind fails by a large margin to equal the other, it should be evident in the experiment as designed.

Some difficulty was encountered in marking trees of the desired average diameter in the second thinning of the crown thinning compartment. An obective of frequent thinning is to salvage mortality that occurs between thinnings. Mortality is mostly among smaller trees of the stand. When their diameters were averaged with marked live trees, the result was an average diameter below the specifications for crown thinning (3 inches above the average for the stand). Thus the rule had to be modified by specifying that average diameter of live trees marked would exceed the average diameter of the stand prior to thinning by 3 inches. In low thinning a similar revision was applied even though marked trees were of the same general size as the dead trees.

Remeasurement of untagged plots (trees marked with a scribe) was found to take longer on the average than remeasurement of tagged-tree plots, because of missed trees or tallying mistakes. It was frequently difficult to reconcile current and earlier tallies on the untagged plots. Although initial establishment of tagged-tree plots takes more time, it is believed more than compensated for by time saved in remeasurement and extra data.

Local volume tables made from the height curve and standard volume tables did not give a smooth progression of volumes from diameter to diameter, because of imperfectly harmonized base tables. interpolated volumes had to be smoothed by curving to produce a satisfactory local volume table. This suggests that future tables might be made by curving sample tree volumes over diameter directly without going through the height-

curve step. Experience with other commercial thinning experiments has shown that after several successive volume tables have been made for the same area, harmonization is necessary to get a logical progression in volumes over the years.

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Response of Pole-Sized White Oak Trees to Release

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HARVEST AND IMPROVEMENT cuttings in uneven-aged hardwood stands commonly release pole-sized trees growing under or near the crowns of the cut trees. This paper gives early growth response of released white oak pole-sized trees and considers how crown class, site quality, and past growth rate influence this response.

The study was conducted in two upland hardwood stands in southern Illinois—one in the Vienna Ranger District of the Shawnee National Forest and the other in the Jonesboro District. Each stand contained two site classes: northerly slopes and coves made up the better sites and southerly slopes and ridgetops the poorer sites. The Vienna District experimental area generally had drier, shallower soils and less dense stands than the Jonesboro.

In all, 196 pole-sized white oak trees were selected for study: 140 were released from overhead shade in March 1954, and 56 were left unreleased. Side shade was maintained on most of the holes.

Trees were separated into "fast" and "slow" past growth classes to determine whether past growth rate influences response to release. This separation was based upon diameter growth for the 10 years preceding release. The distinction was arbitrary, but trees with "fast" growth had grown more than twice as fast as trees with "slow" growth.

In classifying the crowns, the distinction between suppressed and overtopped trees was based on the apparent length of time they had been overtopped as well as condition of the crown. Suppressed trees usually had low vigor and misshapen crowns with a very low ratio of crown length to tree height. Occasionally they were stag-headed.

[1]Silviculturist, Carbondale Forest Research Center, maintained in cooperation with Southern Illinois University, Carbondale, Ill.

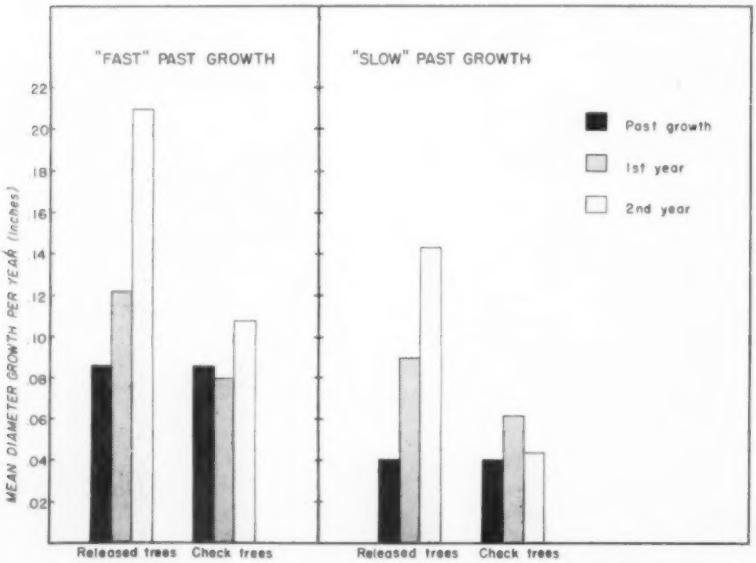

FIG. 1.—Diameter growth of released and check trees, all crown classes and sites combined; Jonesboro replicate.

Results of Study

Pole-sized white oak trees completely released by a harvest and improvement cutting grew 41 percent faster the first year than they had during the average of the previous 10 years (Fig. 1). And they

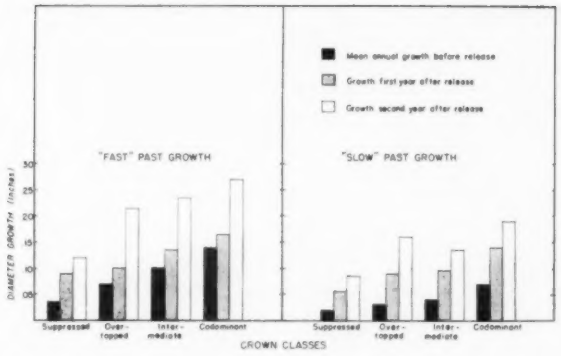

FIG. 2.—Diameter growth of released trees; Jonesboro replicate.

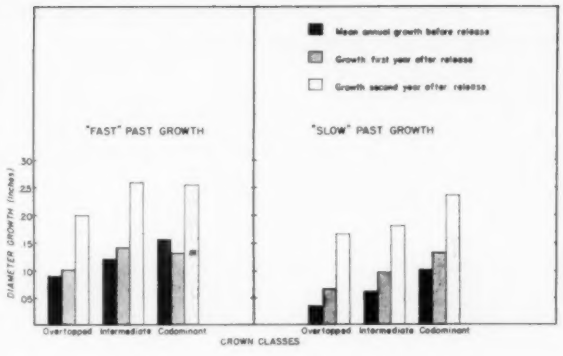

FIG. 3.—Diameter growth of released trees; Vienna replicate.

grew 46 percent faster than the unreleased trees. These increases were statistically significant. The past growth of the released and unreleased trees had been about the same.

Total age in itself did not influence response to release. Released trees ranged in age from about 35 to more than a 100 years. Many century-old, pole-sized white oaks still had good crown form and responded well to release.

Growth and crown class.—Growth before and after release was related to crown class of the trees. Although all crown classes responded significantly to release, codominant trees grew fastest both before and after release (Figs. 2 and 3). (There were no dominant released trees.) Growth of intermediate, overtopped, and suppressed trees generally followed in that order. Second-year growth increased about the same over first-year growth for all crown classes except suppressed. Suppressed trees had a significantly smaller growth acceleration.

Growth and site.—The second year's diameter growth of formerly slow-growing, released trees averaged 0.19 inches on the better sites and 0.15 on the poorer sites. Formerly fast-growing trees showed no difference in second year's growth between sites.

On the generally drier Vienna replicate, differences in moisture supply seemed to make a big difference in growth rate because released trees on the better of these sites increased in growth rate more than those on the poorer sites during the second year (Table 1). The moister Jonesboro replicate, on the other hand, did not show this difference between sites.

TABLE 1.—ACCELERATION[1] OF DIAMETER GROWTH AS RELATED TO CROWN CLASS AND SITE; VIENNA REPLICATE

Original crown class	Site	Released trees	Check trees
		Inches	
Codominant	Better	0.13	0.05
	Poorer[2]	.10	.09
Intermediate	Better	.12	.05
	Poorer	.08	.02
Overtopped	Better	.12	.02
	Poorer	.07	.00

[1]Increased diameter growth second year as compared to first.
[2]These trees received relatively little release because stand density was already rather low.

Conclusion

A harvest and improvement cut resulted in immediate and rapid diameter growth increase of the white oak pole-sized trees released. No adverse effects—such as epicormic sprouting—were apparent after two years, but this will be checked later.

All in all, the best response was obtained from fast-growing codominant or intermediate trees (or overtopped trees that were still vigorous) growing on good sites. Growth response of all trees, however, was so good it appears that, when selecting crop trees, great emphasis can be placed on form and quality.

The Effect of Seed Storage on Seedling Survival of Sugar Pine[1]

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SUGAR PINE (*Pinus lambertiana* Dougl.) is one of the most valuable trees grown in California and southern Oregon and today over two million acres of commercially available forest land support some growing stock of this species. Apparently a considerable effort to maintain and reestablish this species in suitable areas can be justified on economic grounds (*14*).

Direct seeding and the planting of nursery grown seedlings have been tried experimentally and have met with varying success (*1, 4, 5, 6, 8, 9*). Survival of field planted nursery stock has been particularly discouraging. As a consequence, considerably more interest has been shown in the direct seeding potential of sugar pine than in that of its two associated species—ponderosa pine and jeffrey pine—which can be successfully established by planting nursery grown seedlings.

Well recognized as difficulties to overcome in the direct seeding of sugar pine are seed destruction by rodents, seedling destruction by cutworms, and competition from grass and sedge. However, on many occasions sugar pine seeds have germinated well, yet seedling mortality has been high and not ascribable to any obvious cause (unpublished file reports of the California Forest and Range Experiment Station).

Sugar pine, in common with many of the conifers, is subject to periodic seed years. For example, since 1930, good seed years have occurred in 1934, 1936, 1941, 1948, 1952, and 1956 (*2*). Consequently, it has been necessary to rely in part upon stored seed for direct seeding operations. This has introduced a variable which has not been generally recognized, namely, seed age. This has come about because the first year following a seed crop fresh seed is readily available for use, while the year just preceding a good crop, the only seed available may be four, five, or even six years old.

Recently, the author, in the course of an investigation of the dormancy mechanism in pine seed, obtained information pertaining to the keeping quality of sugar pine seed during storage (*12*). The length of storage as well as the temperature of storage were found to have a pronounced effect on both germination and subsequent radicle elongation. This suggested that a different survival pattern for field planted fresh seed and field planted stored seed could be expected.

To evaluate the potential effect of seed storage, a series of experiments was carried on in the laboratory and in the greenhouse. However, before proceeding with the results of these experiments, a brief discussion of the meaning of the term germination is necessary.

Referring to the glossary of technical terms published by the Society of American Foresters (*7*), germination is defined in two ways: "(1) Botanically, the resumption of growth of a seed or spore. Usually recognized by rupture of the seed coat and the appearance of the radicle or hypocotyl (2). In seed testing and nursery practice, the development of a normal seedling from a seed." Thus, by one usage germination is the appearance of the radicle while by another usage it includes the subsequent elongation of the hypocotyl, following the appearance of the radicle, which pushes the seed with the encased cotyledons above the surface of the ground.

Haack (*3*) found it necessary to make a clear distinction between "germination" as determined by the initial protrusion of the radicle and "plant percent" which he defined as the number of seedlings that became established per 100 seeds planted in the seed bed. The plant percent excluded those seeds that germinated, but whose hypocotyl elongation was insufficient to push the cotyledons above the ground.

Tiren (*13*) has reported that the plant percent in *Pinus silvestris* decreases during storage while the germination percent may still remain high. On the other hand, a decrease in the plant percent of *Picea abies* was generally reflected in a concomitant decrease in the germination percent.

Since nursery seed beds are kept moist during the period the plant percent is determined, a difference in initial radicle elongation might have little effect on seedling survival. On the other hand, a difference in the initial radicle elongation of seeds germinating under field conditions might be critical. Thus, one might sow seeds with both a high germination percent and a high plant percent, as determined from nursery tests, but still might not be assured of high initial survival from direct seeding under field conditions.

Procedure and Results

Experiments dealt with: (1) germination and subsequent embryo growth of intact seeds, (2) germination and subsequent embryo growth of seeds from which the inner[2] and outer seed coats had

[1]Work carried on under University of California Agric. Expt. Sta. Research Project 1577.

[2]Inner seed coat here refers to the papery membrane derived from the inner layer of the single integument and the papery cap which is the remains of the nucellus.

been removed, and (3) seedling survival in the presence of different amounts of soil moisture.

Cones were dried in a 120°F. oven until the scales opened. The seeds were then knocked out of the cones, dried at room temperature to an average moisture content of 10 percent, and stored at 77°F., 36°F., and 0°F., in desicators, each containing a beaker of Ca Cl_2, until used.

Seeds were stratified by storing them at 36°F., for 90 days, in moist vermiculite.

Intact seeds were germinated in the bottom of Petri dishes filled with vermiculite. Water was added at regular intervals and the incubator in which the Petri dishes were kept was maintained at 77°F. Germination and subsequent root growth were readily observed by turning the Petri dishes upside down (*11*).

When the seed coats were removed, germination was carried out aseptically in screw top test tubes, partially filled with 1 persent agar, which were placed in an incubator maintained at 77°F. (*10*).

Determination of seedling survival, in the presence of different amounts of soil moisture, was carried out in the greenhouse, in 18-inch-deep wooden flats filled with sandy loam. The greenhouse temperature ranged up to 100°F. in the daytime and down to 68°F. at night.

The germination and growth curves are based upon data from 15 samples of ten seeds each. The samples, despite their smallness, were sufficient in all cases to establish the relative position of the curves. For example when the germination curves were based upon the average of either the first five samples, the second five samples, or the last five samples, the relative position of the germination curves was the same although several of the curves were quite irregular. When specific comparisons were made of points on these curves, e.g., days required for 50 percent of the seeds to germinate, the standard error of the difference of the means was calculated and the t-test used to determine whether or not the differences were significant at the .05 level.

Germination of fresh seeds.—Germination of the unstratified intact seeds was slow, and even after three months, less than 50 percent had germinated (Fig. 1).

When the seeds were stratified, germination was rapid with 96 percent germinated after seven days (Fig. 1).

When the seed coats were removed, germination was the same as if the seeds had been stratified (Fig. 1).

Germination of stored seeds.—After two-year storage at 36°F., germination of the intact unstratified seeds began later and fewer germinated than when the seeds were fresh. However, after stratification seeds germinated as if they were fresh (Fig. 2).

When the seed coats were removed, germination was improved, but not to the same extent as with fresh seeds (Fig. 2).

Thus the germination of stored seeds, unlike that of fresh seeds, was differentially affected by stratification and removal of the seed coats.

The effect of the storage temperature on germination was not apparent when the seeds were stratified, but was apparent when the seeds were unstratified, and the seed coats removed (Fig. 3). When the seed coats were removed: germination of fresh seeds was com-

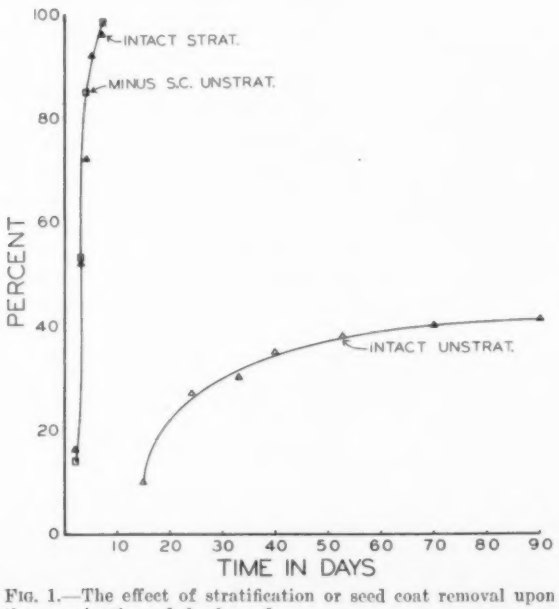

FIG. 1.—The effect of stratification or seed coat removal upon the germination of fresh seeds.

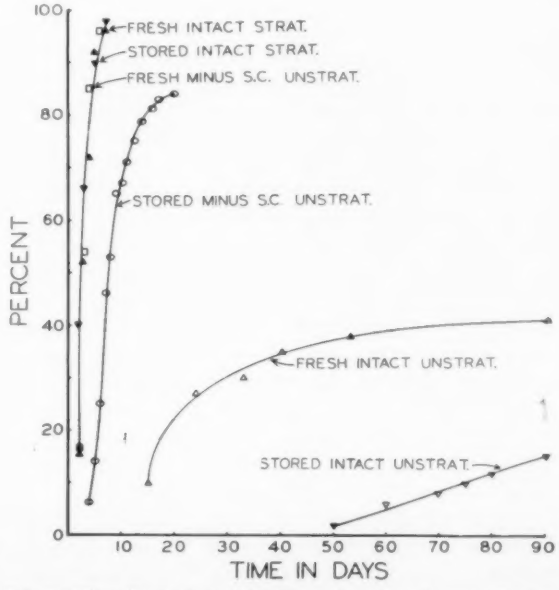

FIG. 2.—The effect of stratification and seed coat removal upon the germination of fresh seeds and seeds stored two years at 36°F.

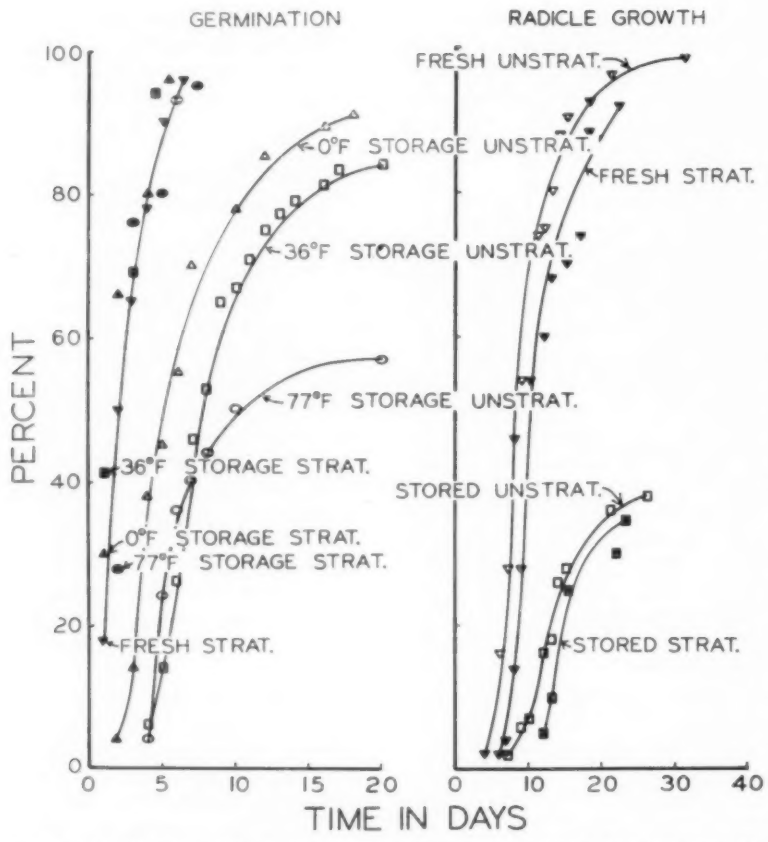

FIG. 3.—(*Left*) The effect of storage temperature on germination and the effect of stratification on overcoming this effect. (Seeds had been stored for two years and had their seed coats removed prior to use.) (*Right*) The effect of storage and stratification on the number of days, after germination, for the radicle to reach 3 inches. (Seeds had been stored at 36°F. and had their seed coats removed prior to use.)

plete in seven days, with 96 percent germinated; germination of seed stored at 0°F. was complete in 18 days, with 91 percent germinated; germination of seed stored at 36°F. was complete in 20 days, with 85 percent germinated; and germination of seeds stored at 77° F. was complete in 20 days, with 55 percent germinated (differences significant at the .05 level).

Elongation of the radicle of fresh versus stored seeds.— Two-year storage at 36°F. had a pronounced effect upon radicle elongation, following germination (Fig. 3). Ninety-eight percent of the fresh seeds developed radicles of three or more inches in 30 days while only 38 percent of the stored seeds did. Furthermore, unlike germination, radicle elongation was unaffected by stratification (Fig. 3).

The temperature at which the seeds were stored had a pronounced effect upon radicle elongation, but unlike germination, was not affected by stratification (Fig. 4). Ninety-eight percent of the fresh seeds developed radicles of three inches or more in 13 days, while 82 percent of the seeds stored at 0°F., 35 percent of the seeds stored at 36°F., and 25 percent of the seeds stored at 77°F. developed radicles of three inches or more in 30 days.

Thus, it is apparent that: (1) the number of seeds that germinate was unaffected by two years of dry storage, provided the seeds have been stratified between storage and germination, but (2) the number of seeds capable of subsequent radicle elongation was drastically reduced (Fig. 4).

Greenhouse survival.—As a measure of potential field survival, fresh seeds and seeds that had been stored at 36°F. for two years were sowed, after stratification, in soil-filled flats in the greenhouse. Ten rows of fresh seeds and 10 rows of stored seeds, each row containing 20 seeds, were sowed one-half inch deep in each of six flats.[3] Each flat was then watered until the entire soil mass was saturated. Three of the flats were not watered again while the other three were brought to field capacity, three times each week, by watering with a sprinkling can.

After two months, approximately 90 percent of the seedlings that had developed from fresh seeds, in both the watered and non-watered flats, were alive (Table 1).

In sharp contrast, survival of seedlings that had developed from stored seeds was higher in the watered flats. In flats watered three times each week, approximately 70 percent were alive after two months, while in flats watered only once, approximately 20 percent were alive (Table 1).

Thus, it is apparent that seed storage can affect seedling survival subsequent to germination.

Preliminary results from a study now underway suggest that once the hypocotyl has pushed the cotyledons above the ground, and they are actively photosynthesising, radicle growth soon becomes independent of the conditions under which the seed was stored. If this is true then continued watering of the flats containing the stored seeds was probably unnecessary, once all the germinated seedlings had pushed off the endosperm and the cotyledon had fully expanded. However, this would still not alter the survival picture shown in Table 1.

It has been shown elsewhere that the germination temperature has

[3]One week before planting each flat had been thoroughly soaked with a solution of orthocide (50 percent Captan) to prevent damping-off.

a pronounced effect upon the relative behavior of seeds stored for different periods of time and at different temperatures (*12*). At higher germination temperatures, (70°F-80°F.) the difference due to storage is less evident than at lower germination temperatures (40°F-.60°F.). Therefore, the experiments reported here were conducted at temperatures close to the optimum for germination and subsequent radicle elongation. Consequently, survival under field conditions would not be expected to be any better than obtained in the greenhouse.

Conclusions

In brief the following conclusions can be drawn, keeping in mind at all times that the storage period was two years and that specific germination temperatures were used:

1. Removal of the seed coats from fresh seeds had the same effect upon germination as stratification. However, after the seeds had been stored for two years removal of the seed coat was not as effective as stratification in accelerating germination.

2. After storage, both germination and subsequent radicle elongation of unstratified seeds were retarded. The retarding effect storage had on germination could be eliminated by stratification, while the retarding effect storage had on subsequent elongation of the radicle could only be partially reduced by stratification.

3. Storage temperatures ranging from 0°F. to 77°F. did not affect the subsequent germination of stratified seeds, but did affect radicle elongation following germination.

4. Dry storage at 0°F. was more effective in maintaining the seeds in a "fresh" condition than storage at 36°F. or 77°F.

5. Greenhouse survival of seedlings developed from fresh seeds was the same in soil that was watered only once in two months as in soil watered three times each week for two months. In contrast, greenhouse survival of seedlings developed from stored seeds was much lower in soil that was watered once than in soil that was watered three times each week.

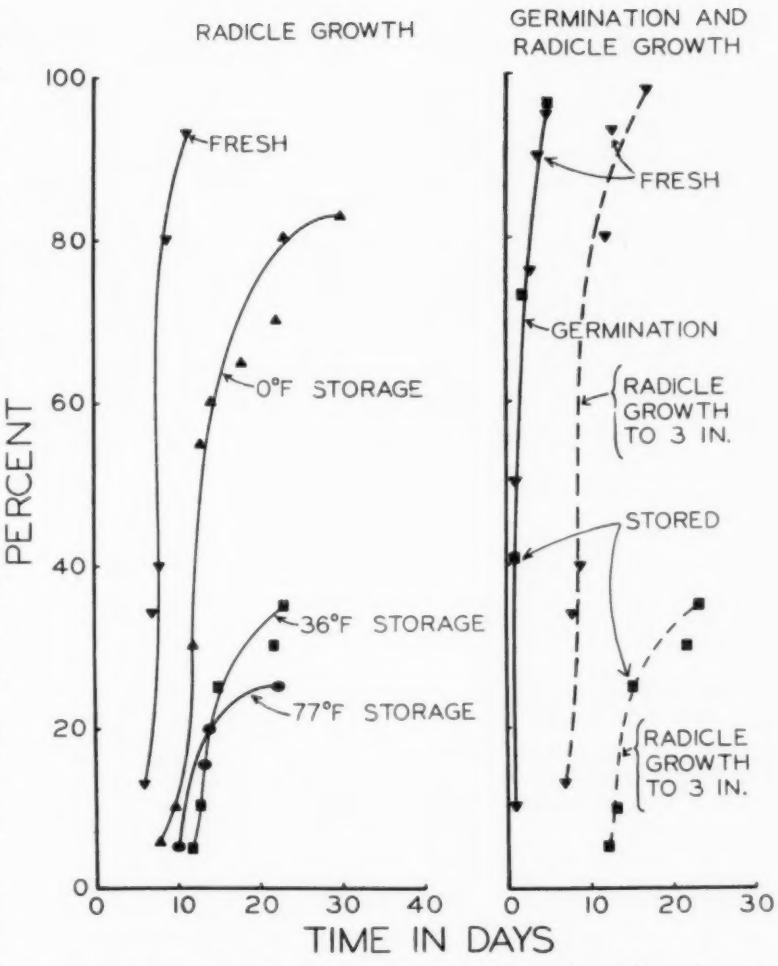

FIG. 4.—(*Left*) The effect of storage temperature on the number of days, after germination, for the radicles to reach a length of 3 inches. (Seeds had been stored for two years and were stratified and had their seed coats removed prior to use.) (*Right*) The effect of storage on germination and subsequent radicle elongation, expressed as days to reach 3 inches. (Seeds had been stored at 36°F. for two years and were stratified and had their seed coats removed prior to use.)

TABLE 1.—GREENHOUSE SURVIVAL, TWO MONTHS AFTER PLANTING, OF TWO-YEAR-STORED SEEDS (36°F.) GROWN IN FLATS WATERED ONLY AT THE TIME THE SEEDS WERE PLANTED, AND IN FLATS WATERED THREE TIMES EACH WEEK. BOTH FRESH AND STORED SEEDS HAD BEEN STRATIFIED PREVIOUS TO PLANTING[1]

Flat number	Watered initially		Watered three times each week	
	Fresh seed	Two-year stored seed	Fresh seed	Two-year stored seed
	Percent survival			
1a	86	8	....	....
1b	....	....	94	78
2a	89	24	....	....
2b	....	....	86	67
3a	88	19	....	....
3b	....	....	88	74
Average	88	17	89	73

[1]Difference in survival of stored and fresh seeds and difference in survival due to watering of stored seeds is highly significant.

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Report on Georgia's Timber Resources Completed

According to a 51-page illustrated report entitled "The Timber Supply Situation in Georgia," by Robert W. Larson, recently issued by the U. S. Forest Service, only 36 percent of the total volume of timber on Georgia's 24 million acres of forest land is large enough or of good enough quality to make saw logs. Four-fifths of the sawtimber cut is pine, but pine makes up only 58 percent of the volume of standing sawtimber.

The report further reveals that the trend in the supply of the kind of timber forest industries use is down. The most recent survey of Georgia's forest resources completed in 1953 disclosed that the state had 15 percent less pine sawtimber than it had 18 years ago when a similar survey was made and is still dropping. Hardwood sawtimber declined 11 percent.

Only the tremendous upsurge in the number of young trees prevented a more serious drop in sawtimber volume.

Georgia's big forestry problem is getting enough of the right kind of trees growing on its forest land. According to the report, a fourth of the forest land is poorly stocked; only about half is fully stocked. It is estimated that cull trees one inch and larger in Georgia, mostly hardwoods, occupy about a third of the available growing space.

The report points out the important progress that has been made toward improving forest practices since the first survey was made. Most of the forest land now has organized forest fire protection. The number of pine seedlings distributed for planting now exceeds 100 million a year. Most of the worked-out turpentined trees can now be used for pulpwood. Turpentining practices have improved. More and more land is being left with an adequate seed source following cutting. And some landowners are making a start toward getting rid of the poor quality hardwoods.

The forest survey upon which the report is based was conducted by the Southeastern Forest Experiment Station in cooperation with the Georgia School of Forestry and forest industries.

Some Further Evidence of Competition Between Loblolly Pine and Associated Hardwoods[1]

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COMPETITION results when the combined demands of plants for the essentials for growth are greater than the available supply. Competition in forests occurs whenever plants grow so close together as to result in a struggle for light above ground and for moisture and soil nutrients below ground. It causes the overtopping, suppressing, and crowding out of the weaker individuals by more vigorous and more aggressive trees.

Differences between individuals within a species in their response to competition results in an expression of dominance by the more aggressive trees. In mixed stands the most aggressive species usually become dominant. When they are able to maintain their competitive advantage and reproduce successfully they are usually considered as being relatively more tolerant than their associates. This gives rise to the concept that tolerance is "the capacity of a tree to develop and grow in the shade of and in competition with other trees."[2] It is "a general term for the relative ability of a species to survive a deficiency of an essential growth requirement, such as light, moisture, or nutrient supply."

The relative tolerance of the different species when in intense competition is very important in determining their respective roles in the natural succession of forest communities toward the climax type for a given climatic area.

Studies were begun at Duke University in 1932 to obtain additional evidence on the part played by the interacting factors of light and soil moisture in the competition, the expression of dominance, and the relative tolerance of loblolly pine (*Pinus taeda* L.) and its commonly associated species of angiosperms. Comparative studies were made of soil moisture and light intensity on seven sets of trenched and untrenched plots in loblolly pine, shortleaf pine, post oak–blackjack oak, white oak–black oak–red oak and red gum–yellow-poplar forest types.[3] The results showed that in closed stands in which light intensity was essentially the same a deficiency of soil moisture during the growing season was responsible for the death of pine seedlings one to two years old on the untrenched plots. The angiosperms, commonly present in the understory or sometimes newly germinated, usually persisted, although they sometimes died back and sprouted out again.

Trenching was followed by increases in the number of all species and in general luxuriance of the vegetation. Subsequent observations, however, indicated that after six to ten years the pine trees on the trenched plots became unthrifty and began to die. After a lapse of 10 to 15 years nearly all of the pines had died indicating that, apparently because of the relative intolerance of the pine trees to the shade of the overstory, a deficiency of light may have caused their ultimate death. This conclusion is supported by the results of a recent experiment suggesting that reduced light intensity is an important factor in the poor survival of pine seedlings under forest stands.[4]

These results are in accord with earlier research[5] which showed that at reduced light intensities hardwoods are photosynthetically more efficient than pines. This fact suggested that the lesser growth and smaller root systems of pine seedlings grown in the shade are likely to result in inadequate photosynthesis. Although under adequate light intensity pines can grow where moisture conditions are equal to or less than the needs of hardwoods, it appears that in shade they are unable to grow and develop successfully. In other words the survival and growth of pines require a light intensity high enough for them to produce sufficient food to develop root systems capable of absorbing the necessary water.

These considerations emphasize the interrelationship of the complex factors involved in competition and that not only the environmental factors of light intensity, soil moisture, and dissolved nutrients but also the relative photosynthetic efficiency and root habit and development are involved in relative tolerance.

In an effort to obtain additional evidence on the interactions and relative importance of these environmental factors another study was initiated in the Duke Forest in 1951. Sixty loblolly pine seedlings seven years old were selected from an even-aged stand of loblolly

[1]Presented at 12th Congress, International Union of Forest Research Organizations, Oxford, England, July 1956.

[2]Forestry Terminology. p. 85. Society of American Foresters. Washington, D. C. 1950.

[3]Korstian, C. F., and T. S. Coile. Plant competition in forest stands. Duke School Forestry Bul. 3. 125 pp. 1938.

[4]Kramer, P. J., H. J. Oosting, and C. F. Korstian. Survival of pine and hardwood seedlings in forest and open. Ecology 33:427-430. 1952.

[5]Kramer, P. J., and J. P. Decker. Relation between light intensity and rate of photosynthesis of loblolly pine and certain hardwoods. Plant Physiol. 19: 350-358. 1944.

pine and hardwoods. The hardwoods included a variety of species indigenous to mesic upland sites of the North Carolina Piedmont Plateau. The experimental area represented a high quality site as indicated by an abundance of yellow-poplar (*Liriodendron tulipifera* L.).

Twenty pines were randomly selected for each of the following treatments:

1. Both crown and root competition was greatly reduced by killing all woody plants within 33 inches of the pines with Ammate (ammonium sulfamate).

2. Crown competition was greatly reduced by tying back all woody plants capable of shading the pines, leaving root competition undisturbed.

3. The pines in this group were allowed to compete with the associated species above and below ground. They served as the control for treatments 1 and 2.

Height and diameter growth was recorded for four succeeding growing seasons. Growth analyses for the first two growing seasons indicated that the unreleased control pines grew significantly less than those in treatments 1 and 2. There was, however, no significant difference between the growth of the pines under treatments 1 and 2. At that time treatment 1 was modified by poisoning all woody plants within 12.5 feet of the pines.

The accompanying table includes the adjusted treatment means of height and diameter growth for the four years. Adjusted means indicate the treatment means which would have been obtained had the group means been the same at the beginning of the experiment.

Because of the high site quality of the area which probably had an adequate amount of mineral nutrients required for the growth of forest trees, the root competition in this experiment represents mainly that for available soil moisture.

TABLE 1.—ADJUSTED TREATMENT MEANS OF HEIGHT AND DIAMETER GROWTH FOR FOUR YEARS

Treatment	Height		Diameter	
	Adjusted mean growth	Average difference between adjusted treatment means	Adjusted mean growth 1 inch above ground	Average difference between adjusted treatment means
	Inches	*Inches*	*Inches*	*Inches*
1. Hardwoods poisoned	98.7	Treatment 1 minus Treatment 2 14.2*	2.34	Treatment 1 minus Treatment 2 0.67*
2. Hardwoods tied back	84.5	Treatment 1 minus Treatment 3 37.8**	1.67	Treatment 1 minus Treatment 3 1.40**
3. Control	60.9	Treatment 2 minus Treatment 3 23.6**	0.94	Treatment 2 minus Treatment 3 0.73**

*Significant at 5 percent level.
**Significant at 1 percent level.

Average light intensity available to the crowns of the experimental pines was measured on a clear day between 10:30 A.M. and 3:00 P.M. It was expressed as a percentage of the light intensity measured in an open field during the same period. The calculated values for treatments 1 and 2 were the same; namely, 73 percent of full sunlight and that for the untreated control was 35 percent. Since there was no significant difference in the intensity of light available to the pines in groups 1 and 2, the differences in average growth of the treatment groups can be attributed to differences in available soil moisture. Thus the trees in group 1 grew significantly more than those in group 2 because they had access to more available soil moisture during the growing season.

The difference in light intensity apparently accounts for the variation in growth of groups 2 and 3. The pines within group 2 were exposed to twice the intensity of light available to those in the control.

The combined effect of deficient light and soil moisture is reflected in the growth and general appearance of the treated and control pines. Most of the treated pines appeared healthy and vigorous. They had well developed leaders and long crowns composed of first to fourth order branches. The dark green needles pointed upward, forming an acute angle with the stems.

Most of the control pines had an unthrifty chlorotic appearance. Many of them were completely overtopped by competing hardwoods. Three control pines died during the last growing season. It is interesting to note that all three dead pines had been exposed to the lowest light intensity within the control group.

The present experiment further emphasizes the importance of both light and soil moisture as vital factors in the growth and development of loblolly pine when in competition with hardwoods. Either deficient soil moisture or inadequate light intensity can become a limiting factor and the interacting combination of both usually prevents the survival of this species under such conditions. Thus the death of the intolerant pine permits the more tolerant and commonly slower growing hardwoods ultimately to dominate the stand and become the climax in the natural succession.

Effects of Prescribed Burning in Second Growth Ponderosa Pine[1]

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PRESCRIBED BURNING and stand improvement have been used for reduction of fire hazard in a second growth ponderosa pine stand on the Klamath Indian Reservation in southern Oregon. Results and interesting ecological changes are herewith briefly described and illustrated by photographs.

Stand Conditions

Early logging for government owned sawmills, operated by the U. S. Army and Bureau of Indian Affairs, covered an area roughly estimated at several thousand acres along the western boundary of the reservation. Cutting extended along the accessible timber fringe, bounding open grasslands and marshlands to the west, from Fort Creek south about ten miles to the east shore of Agency Lake. Most of these cutover lands now support excellent second growth ponderosa pine of 65 to 75 years in age, though groups of younger reproduction are occasionally encountered. Rare overstory trees that survived logging and subsequent wood cutting and pine beetle attacks indicate that the original mature stand was comprised of trees of large size and excellent quality.

The treated portion of this second growth stand covers approximately 100 acres in the immediate vicinity of Klamath Indian Agency, where one of the government sawmills operated during the 1880's and 1890's. Most of this area appears to be of site index III. It is understood that burning for hazard reduction was conducted on a portion of this area during the early 1920's, under the supervision of James A. Howarth Jr., supervisor of forests. No records survive that describe areas treated, methods, or results. In any event, the practice had been discontinued for many years before burning herein described.

By the late 1930's dead needles and litter comprised a mat many inches deep on the ground. In the crowded stand deadened lower

[1]This article represents the author's views and is not to be regarded as an official expression of the attitude of the Bureau of Indian Affairs on the subject discussed.

FIG. 1.—Conditions typical of the stand before prescribed burning. Bitterbrush shrubs had been partly smothered and deadened by heavy needle accumulation. Needles were disturbed only in immediate vicinity of shovel. Photo in December 1939, immediately adjacent to treated area.

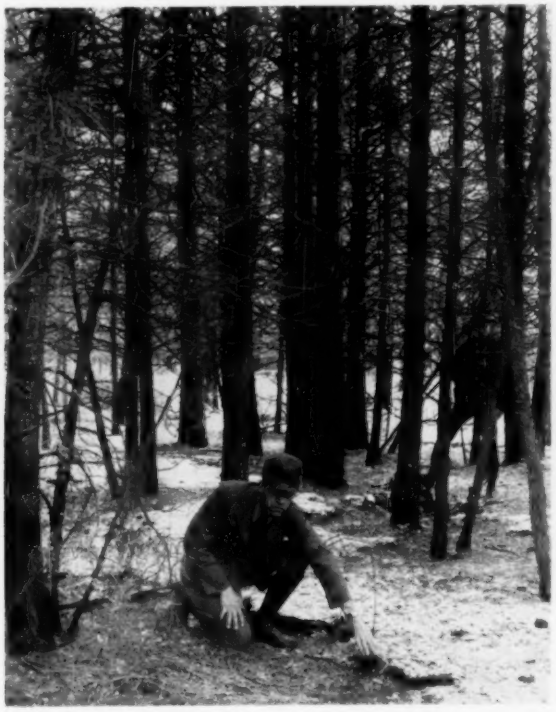

FIG. 2.—Edge of partially burned needle mat where prescribed fire burned down to mineral soil. Fallen needles accumulated in late autumn after burning. Photo in December 1939.

branches, festooned with fallen needles, covered each bole from near the ground upward 16 to 20 feet to green branches of the upper crown (Fig. 1). Small openings were occupied by dense bitterbrush (*Purshia tridentata*) also festooned with fallen needles. Snags and windfalls of beetle-deadened trees, old cull logs, and other debris added to the fuel.

Several fires starting near the Agency during critical weather crowned small patches of this pole stand, before being controlled through strenuous application of all available manpower and facilities. They caused concern on the part of officials responsible for safety and protection of the Agency and its employees. In August 1939, there occurred a dramatic demonstration of what fire out of control could do in such second growth stands. Fire that destroyed the Pine Ridge Sawmill and village, population 400, near the town of Chiloquin on the Southern Pacific Railroad, swept and spotted over the hills from the east, despite efforts of hundreds of men with heavy equipment, jumped small fields, roads, and highways and spent itself only on the shore of Agency Lake. More favorable late night conditions enabled control along the flanks, after the fire had burned over 5,400 acres and had almost completely destroyed hundreds of acres of second growth pine. With a slight shift in wind this fire would have included the Agency in its sweep.

Prescribed Burning and Stand Improvement

In an effort to reduce extreme hazard in the surrounding second growth stands George Kephart, forest manager, and Harry Kallander, forester, in charge of fire control, conducted prescribed burning during the month of November 1939.[2] The area was subdivided into small blocks and narrow strips by means of tractor-plowed fire lines. These were burned during favorable weather at night time. The upper portion of the heavy needle and litter mat was largely consumed. However, under denser tree groups and adjacent to spots where heavy fuel burned with considerable heat the fire burned down to mineral soil (Fig. 2). A great volume of heavy fuel in windfalls, stumps, and snags was also largely consumed. Bitterbrush and other shrubs were deadened. The burning was so skillfully conducted that but very few young pines were crowned by the fire.

During the winter of 1940-41 Indian Civilian Conservation Corps crews were employed on stand improvement work designed primarily to further reduce fire hazard.[3] Smaller suppressed trees were chopped down and boles of all reserved trees were pruned of dead branches to a height of 18 feet above ground. Slash resulting from these operations was all piled and burned.

Subsequent to stand improvement the treated area has been burned annually to prevent further accumulation of dead needles and other inflammable debris. Victor Sisson, fire control officer, has during recent years expanded the treated area as rapidly as limited funds and personnel permit.

Results and Discussions

Though we have no data for presentation and analysis it is apparent from observation that fire hazard has been greatly reduced by the prescribed burning. The ground has been almost completely cleared of debris and fires during critical periods are easily controlled. During the fall of 1955 a fire driven by a 30 mile per hour wind from the south was easily controlled when it reached the treated area. With pruning of the tree boles there appears remote possibility of crown fires ever developing, unless fuel is again permitted to build up on the ground. (Figs. 3, 4).

If annual burning has damaged the soil there is no observable evidence of the effect on tree growth. Though portions of the stand are still too crowded, dominant and codominant trees are making rapid height and diameter growth. Branch stubs and pruning scars are becoming well covered.

Prescribed burning and stand improvement should be applicable under similar conditions in other second growth ponderosa pine stands of the Klamath region. The value of these fast growing stands is such that necessary expense should be fully justified for assurance against devastating fires and for increased quality and value of crop trees. After initial treatment subsequent burning to keep down hazard can be cheaply applied at intervals of three or four years.

Under a more open portion of the stand north of the Agency a considerable area of ground under the trees that was dominated by bitterbrush before the 1939 burning has been taken over by heavy grass. (Fig. 4). There is no record of this grass having been planted. Indeed the principal component is Idaho fescue (*Festuca idahoensis*), a native species. Mr. Sisson confirms that this is a natural grass stand and that to his knowledge there has been no planting.

This should raise speculation concerning possibility of using prescribed burning for control of ground cover in the Klamath region. We have always considered Klamath a problem area with respect to establishment of reproduction because of the critical moisture factor in the loose pumice soils and particularly because of the various shrub species that compete seriously with ponderosa pine reproduction. When the forest is opened through selective logging or beetle attack various shrubs such as bitterbrush, manzanita, and ceanothus are most apt to take over all available growing space in the absence of good pine seed years and favorable moisture conditions. In such event establishment of reproduction may require a very

[2]Weaver, Harold. A photographic report of fire hazard reduction project, Klamath Indian Reservation, Oregon. Bureau of Indian Affairs report. 1939.

[3]Kephart, George. CCC—ID project no. 244. Timber stand improvement at Klamath Indian Agency, Oregon. 1941.

FIG. 3.—Typical portion of treated stand in July 1954, following original prescribed burning, stand improvement, and subsequent annual burning to prevent accumulation of fuel.

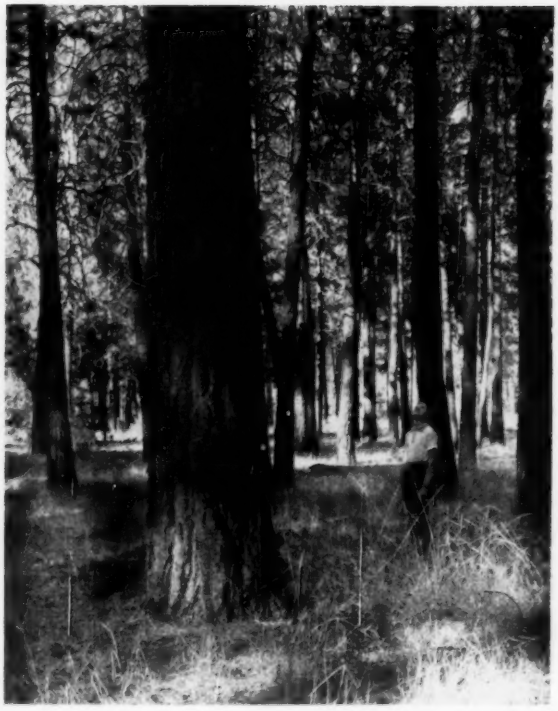

FIG. 4.—Another portion of the treated stand in August 1955. Note heavy grass ground cover.

long time. Despite leaving of an excellent reserve stand, a recent cruise disclosed that approximately 20 percent of the cutover lands are not satisfactorily stocked with reproduction. On some of these lands cutting occurred as long as 30 to 40 years ago.

Bitterbrush appears particularly obnoxious, though it is highly thought of by range managers as a browse plant. In my opinion its present distribution and extreme density over portions of Klamath are the result of our efforts at total fire exclusion over the past 40 to 50 years. Early observers testify that while various shrubs were present under the pines in the 1880's and 1890's, they never developed to present size and density because of frequent recurrent fires. They also testify that the forest floor was grassy.

I have observed that bitterbrush is readily killed by fire. On portions of the areas where it was formerly dominant in ground cover before the Pine Ridge Fire of 1939, for instance, it still has not come back. These areas are now grassy in general aspect, despite sheep grazing, with fescue comprising the dominant grass species. (Fig. 5). Also of significance are groups of ponderosa pine reproduction that have become established on and immediately adjacent to heavily burned spots. Extensive portions of the burn, however, are now covered by manzanita.

In my opinion there will have to be developed feasible, economical methods of controlling shrubs and of reducing hazard if intensive forest management is to be practiced in the Klamath region. Prescribed burning should be tested and evaluated for use for such purpose. Because of critical soil-moisture relationships, above mentioned, extreme inflammability of various shrub species and great hazard in dead windfalls resulting from severe pine beetle epidemics of the 1920's and 1930's such tests should be conducted with great caution.

Summary and Conclusions

On the Klamath Indian Reservation in southern Oregon a dense, even-aged, fast growing ponderosa pine stand of large pole size was treated by prescribed burning in 1939 for purpose of reducing high fire hazard. Very few of these young trees were damaged. During winter of the year following stand improvement was applied, also for the primary purpose of further reducing hazard. Suppressed trees were cut, boles of reserved trees were pruned of dead branches to a height of 18 feet above ground and all resulting slash was piled and burned. Annual burning has since been applied to prevent further accumulation of needles and litter.

Wild fires are now easily controlled and it appears that there is but remote chance for occurrence of devastating crown fires. Continued rapid diameter and height growth is apparent in dominant and codominant trees.

Part of the treated ground under the pines now supports a heavy native grass stand, instead of bitterbrush that dominated before

FIG. 5.—On this area bitterbrush dominated as ground cover before the Pine Ridge Fire of August 1939. Dry, deadened branches of larger bushes still litter the ground. Note heavy grass, also clump of ponderosa pine reproduction in foreground, where beetle deadened windfalls burned. Photo in August 1955.

burning. This should stimulate speculation on possibility of using prescribed burning for control of ground cover.

Prescribed burning and stand improvement should be applied in similar stands and under similar conditions for insurance against devastating fires. The possibility of using prescribed burning for control of ground cover in the Klamath region should also be carefully investigated. It is believed that success in future management in this region will depend in considerable part on control of various shrub species that compete seriously with ponderosa pine reproduction.

It is hoped that research foresters will further study the treated stand and other conditions described, for on the Klamath, as well as in other portions of the ponderosa pine region, it is believed that protection, regeneration, and continued development of ponderosa pine is dependent to a considerable extent on use of fire under proper control.

Foreign Forestry Aided by Surplus Crop Sales

The message from the President of the United States transmitting the Sixth Semi-Annual Report on Activities Carried on Under Public Law 480—House Document No. 212, 85th Congress, includes the following information of interest to foresters:

Under PL 480, the U. S. is selling four billion dollars worth of its surplus farm crops to foreign countries, for local currencies. To the countries participating in PL 480 Agreements, an average of some 60 percent of those local currencies are being loaned for periods of as much as 30 years—some longer—at interest rates of 3 percent if repaid in dollars, or 4 percent if repaid in local currencies. The loaned funds are available for use for "economic development," under the general supervision of the International Cooperation Administration.

Many classes of projects, on which the loan funds may be used, have been approved as of June 30, 1957. Among those of particular interest to foresters are the following:

Israel: "Afforestation ..... $ 400,000
Japan: "Forest Development $2,800,000
Spain: "Reforestation and Watershed control" $5,100,000

In Spain this equals more than 50 percent of all classes of loan projects approved.

In Colombia 10 percent of the 25,000,000 pesos of total loan funds to date have been allocated to "reforestation." With that precedent it may be expected that other of the seven South American countries which have PL 480 Agreements and resulting loan funds, will also make some use of them for forestry purposes.

Experimental Induction of Female Flowers on Young Slash Pine

P. E. Hoekstra and
François Mergen[1]

DESPITE the expansion of southern forest nurseries, few southern states today can keep up with the demand for tree seedlings. One fundamental difficulty is that the amounts of high-quality seed required by the nurseries do not exist.

To aid the enlarged planting program, two principal techniques for quantity production of superior seed are being tested, namely, seed production areas and seed orchards. In the former, cone-bearing stands are thinned to 20 or 30 of the best-formed trees per acre. In the latter, seedlings or vegetatively propagated material are obtained from parents which transmit desirable characteristics to their progeny. The main purpose of these plants is to produce seed of high genetic quality; hence it is important that they come into full cone production as soon as possible. In the slash pine belt, a number of pulp companies and several national forests have installed seed production areas. Also, more than a dozen seed orchards are being established or are in the planning stage in the South.

In these areas and orchards, larger seed crops would be obtained if the number of female flowers formed every year could be increased. There have been indications that this increase can be achieved by releasing, fertilizing, and injuring pine trees. A test of this hypothesis has been provided by two studies on floral induction of slash pine (*Pinus elliottii*, Engelm. var. *elliottii*), and the results lend support to the theory. In Study I, root pruning, strangling, partial girdling, and four levels of a commercial fertilizer application were tested in a 6-year-old plantation. Study II involved application of three levels of two commercial fertilizers and partial girdling in a stand of 21-year-old trees. Induction was studied in terms of emerging female flowers in one year only, and the impact of destructive agents after the flowers emerged was not included.

Literature Review

Fertilization for greater fruitfulness has long been a standard practice in horticulture. In forestry, however, only a limited number of attempts to increase seed crops by fertilization have been reported.

Gemmer (*5*) treated longleaf pine trees over a period of 5 years with pine-needle mulch, irrigation, sodium nitrate alone and combined with irrigation, and with a complete fertilizer plus irrigation. Greatest response followed treatment with complete fertilizer plus irrigation: 62 cones per treated tree versus 2 cones per check tree.

Allen (*1*) reported the results of fertilizing and releasing longleaf pines. Trees 8, 10, and 12 inches d.b.h. received 19, 30, and 44 pounds, respectively, of a 5-15-5 fertilizer. After 3 years, these trees bore 12 times more cones than untreated ones, which produced only 1.8 cones per tree. Four years after treatment, the fertilized trees bore four times as many cones as the controls (0.9 cones per tree). Releasing the trees increased cone production to a lesser extent than fertilization. Allen remarked that 3 years after treatment those which were bearing cones before treatment produced 14.7 cones per tree, as compared to 4.5 cones per tree for those which had not fruited before the study began.

Wenger (*10*) reported on an experiment involving fertilization and partial girdling of loblolly pine trees in the 25- and 40-year age classes. A 7-7-7 fertilizer was applied in amounts of 25 and 50 pounds per tree. No significant response was observed from fertilizing the 40-year-old trees. Treatment of the younger trees resulted in about a three-fold increase in the cone crop as compared to that of untreated trees, but no significant difference in response between light and heavy application of fertilizer could be demonstrated. The average number of cones per tree was 36 for the control, and 98 and 123 for those fertilized at the rate of 25 and 50 pounds, respectively.

In an attempt to increase the fruit crop, injury to the stem and root system has been tried with success by horticulturists, and in some instances by foresters. Stem-injury may take the form of girdling or strangulation. It retards the movement of photosynthates from the leaves down to the roots, and may retard the flow of water and nutrients from the roots upward.

Arnborg (*2*) banded and girdled Scots pine, a treatment which doubled cone production. The experiment reported by Wenger (*10*) included a knife-cut halfway around the tree. This cut healed over in about 6 weeks, and had no effect on cone production. In a small side study a ¼-inch strip of bark and cambium was removed halfway around the stem. This wound did not grow over, and 53 cones per girdled tree resulted, versus 15 cones per check tree.

Working with 25- and 35-year-old red pine trees, Hitt (*6*) re-

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ported an increase in male and female flower production after he used a double semicircular girdle or a spiral girdle. Trees on which he applied a wire strangulation were much slower to respond to treatment. The stimulation in male flower production showed a decline after the fourth year.

Strangling, girdling, and root pruning were applied to Scots pine and Norway spruce by Stefansson (*9*). On the girdled trees he left at least 2 inches of bark intact; the roots were pruned at least one meter away from the stem. All three treatments markedly stimulated flowering after two or three seasons. In his report of forest genetics activities in Scandinavia, Bouvarel (*4*) mentioned that in general root pruning gave more promising results than either girdling or strangling.

Near Alexandria, Louisiana, Mann and Russell (*7*) found that ringing or partial girdling more than doubled cone and seed production of second-growth longleaf pine trees 6 to 12 inches d.b.h.

Study I: Stimulation of Early Flowering on 6-year-old Slash Pine Trees

Slash pine has borne female flowers at 7 years in the Arboretum of the Institute of Forest Genetics at Placerville, California (*8*). In their natural habitat, slash pine trees normally start to flower between the ages of 10 and 20 years (*3*). In view of these reports and other observations in the field, a study was initiated in a 6-year-old slash pine plantation to investigate the effect of stem-injury, root-pruning, and fertilization, on early flowering of this species. The trees were 7 years old from seed and they had not flowered previously. They were spaced 8 by 8 feet on a cleared sandy soil (Blanton series). The average diameter at breast height was 3.4 inches, and average total height was 16.5 feet.

Experimental methods. — The study was designed for a 3 x 2 x 4 factorial analysis involving a total of 864 trees. A double split plot design with three replications was used, each replication consisting of 24 plots, with 12 trees per plot. The replications were split into four levels of fertilizer, and each fertilizer treatment was subdivided into two root-pruning treatments. The stem-injury treatments were assigned at random to three plots within the pruning treatments.

Stem-injury included strangling and girdling, with no injury as control. For strangulation, the loose bark was scraped off at 2 feet above the ground, and a single strand of No. 9 telephone wire was tied firmly around the stem. On the girdled trees, bark and cambium were removed in two half-circles of ½-inch width, on opposite sides of the tree. The two wounds were 3 inches apart vertically, to permit some sap movement.

The roots of half of the trees in the experiment were pruned with an axe to a depth of 1 foot. They were severed in a circle of 2-foot radius. The remaining trees were not root-pruned.

A 3-12-6 fertilizer was used in applications of 5, 10, and 15 pounds per tree; control plots received no fertilizer. All fertilized plots received 5 pounds per tree at the start of the experiment during the second week of April 1954. Plots with medium as well as high fertilizer application received another 5 pounds after 6 weeks, and the high-level plots received another 5 pounds 12 weeks after the start of the experiment. The different fertilizer dosages were separated by isolation zones to prevent the effects of leaching. The fertilizer was applied to each tree individually, spread over the crown projection area in the case of unpruned trees, and restricted within the root pruning circle of the others. For the unpruned trees, 5 pounds per tree was the equivalent of about 218 pounds of nitrogen per net acre fertilized.

During the latter part of February 1955, all the female flowers were counted on the upper three whorls of each tree in the experiment.

Results and conclusions.—The plots which received no fertilizer and those which received no stem-injury showed practically no flowering response. Only one tree in the unfertilized plots produced flowers, versus 23, 26, and 31 flowering trees in the fertilized plots (Table 1). Only three trees bore flowers in the plots which received no stem-injury versus 22 and 56 flowering trees for the strangled and girdled plots, respectively. The differences were even greater when response was expressed in total number of flowers produced per treatment. On the basis of these observations, it was concluded that both the application of fertilizer and stem-injury had a stimulating effect on the production of female flowers.

Data on number of flowering trees per plot were subjected to an analysis of variance. The controls for fertilizer and stem-injury, however, were excluded from this analysis since most of these plots had zero values and consequently no variance. The following conclusions are based on the analysis of the data:

1. Girdling had a much greater stimulating effect than strangling. Statistically, the difference was highly significant (1 percent level).
2. Root pruning substantially increased the number of flowering trees (1 percent level).
3. An increase in the amount of fertilizer beyond the initial 5-pound application did not have a statistically significant effect.

TABLE 1.—NUMBER OF 7-YEAR-OLD SLASH PINE TREES (OUT OF 36) BEARING FEMALE FLOWERS, BY TREATMENT

Fertilizer	No stem injury		Strangled by wire		Partially girdled	
	Roots pruned	Not pruned	Roots pruned	Not pruned	Roots pruned	Not pruned
	Number					
None	0	0	0	0	1	0
5 lb.	1	0	6	2	10	4
10 lb.	0	0	5	4	10	7
15 lb.	1	1	4	1	17	7

4. None of the interactions showed significance in the analysis. Since the controls for fertilizer and stem-injury were excluded, however, all possible interactions could not be tested.

The number of flowers was highly erratic from tree to tree, ranging up to 73 flowers on one sapling.

Study II: Stimulation of Abundant Flower Formation on Older Slash Pine Trees

In the second study, an attempt was made to stimulate greater flower production on older cone-bearing trees by stem-injury and fertilization. The experiment was conducted on part of a seed production area of 21-year-old trees located on a fine sandy soil (Plummer series) on the lands of the National Container Corporation near Lake Butler, Florida. The stand had been established by planting 1-0 seedlings 9'0 feet apart. The whole stand had been thinned to about 25 of the best trees per acre a year prior to installation of this experiment; hence the effect of release was not studied. The average diameter of the trees at breast height was 11.3 inches, and average total height was 56 feet.

Experimental methods.—In this study, a total of 150 trees was used, divided into five randomized blocks, each containing 10 plots of three trees. Eight plots per block were used for the treatment combinations of two levels of injury, two types of fertilizer, and two levels of application. The remaining two plots were assigned to no treatment (control), and to girdling without fertilization. Plots were spaced at least 50 feet apart to prevent contamination between the various fertilizer treatments.

The two levels of stem-injury consisted of partial girdling and no girdling. In the girdling treatment, bark and cambium were removed in two half-rings ½ inch in width and spaced 2 feet apart vertically, on opposite sides of the stem. The lower wound was made about 1 foot above the ground.

Two levels of 7-7-7 and 3-18-6 commercial fertilizers were used. The lower level consisted of 20 pounds of fertilizer per tree applied during the third week of April 1954. The higher level consisted of 20 pounds applied at the same time as the lower level, with another 20 pounds applied 6 weeks later. Fertilizer was applied by hand to an area extending 2 feet beyond the crown projection. Equivalents per net acre fertilized are shown in Table 2.

During the latter part of February 1955, a sample branch was collected from each tree. Sampling was restricted to branches which pointed toward the south and grew where the stem diameter was 4 inches. All buds and female flowers were counted on the selected branches.

TABLE 2.—FERTILIZER DOSAGE, STUDY II, ON AN ACRE BASIS

Treatment	N	P_2O_5	K_2O
	Pounds		
7-7-7			
Low level	194	194	194
High level	388	388	388
3-18-6			
Low level	83	500	167
High level	166	1,000	334

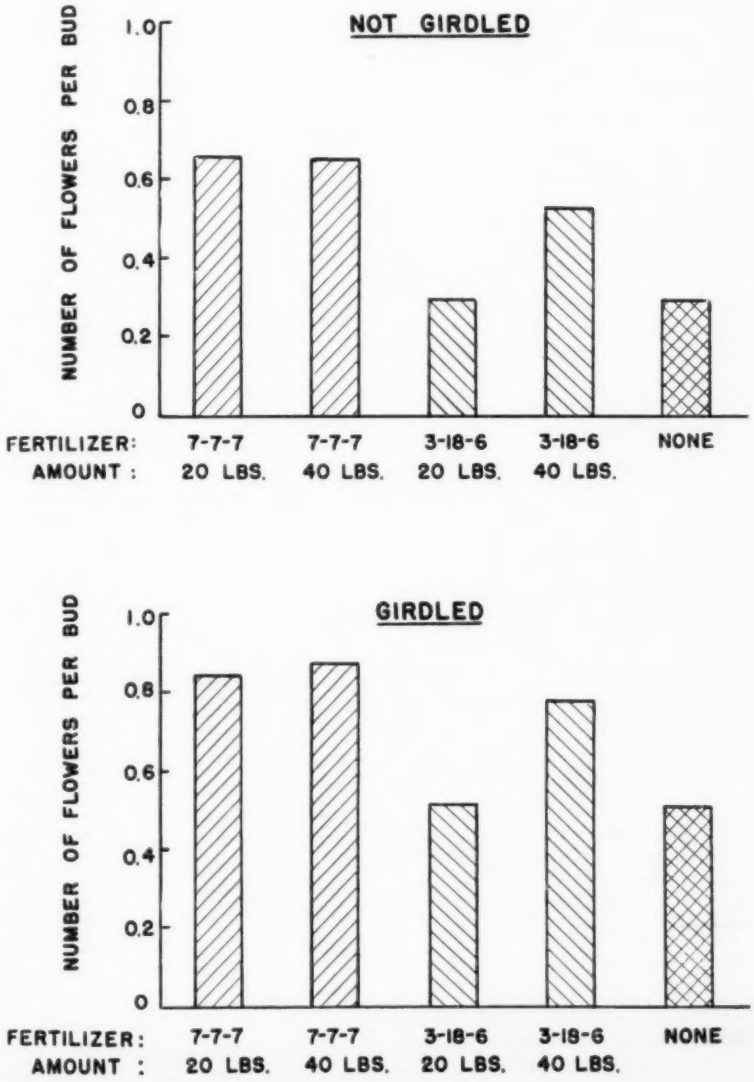

FIG. 1.—Average number of female flowers per bud, following various treatments, on 21 year-old slash pine.

TABLE 3.—FEMALE FLOWERS PER BUD ON 21-YEAR-OLD SLASH PINE TREES, SUMMARIZED BY TREATMENT AND YEAR

Year of count	Type and amount of fertilizer				
	7-7-7		3-18-6		
	20 lbs.	40 lbs.	20 lbs.	40 lbs.	None
	Number				
GIRDLED					
1955	0.85	0.87	0.52	0.77	0.51
1956	0.69	0.51	0.37	0.50	0.43
NOT GIRDLED					
1955	0.66	0.65	0.30	0.53	0.30
1956	0.41	0.42	0.26	0.46	0.15

Results and Conclusion

The branches differed little in size, but showed great variety in total number of buds (range 10 to 50). The total number of female flowers per branch was divided by the total number of buds so that the number of flowers per bud could be computed (Fig. 1).

The data on female flowers were subjected to an analysis of variance. Three major comparisons were statistically significant at the 5 percent level: fertilizer versus no fertilizer, 7-7-7 versus 3-18-6, and girdling versus no girdling. Differences between levels of fertilizer application and interactions between treatments were not statistically significant. Based on analysis of the data, the following conclusions were made:

1. Applications of fertilizer resulted in an average increase of flower production of 59 percent over controls.

2. The 7-7-7 fertilizer with its high nitrogen content provided a greater stimulus for flower formation than did the 3-18-6 fertilizer with its high phosphorus content.

3. Girdling the trees increased the flower crop significantly and its effect was independent of the dosage and type of fertilizer.

These results indicate that nitrogen was the more important element in stimulating flowering. The 7-7-7 fertilizer was somewhat more than twice as effective, on the average, as the 3-18-6 fertilizer, even though the latter contained much more phosphorus and nearly the same amount of potassium. The effects of the fertilizers were, therefore, almost exactly proportional to the amounts of nitrogen they contained. Although the effect of fertilizer level was not statistically significant, the apparent difference in response to levels between the two fertilizers suggests two additional, related points about these applications. The second application of 3-18-6 fertilizer was associated with an appreciable increase in flower production, indicating that the second applications were made in time to affect flowering in the same year as the first application. The second application of 7-7-7 fertilizer, however, was not followed by increased flowering. This difference in response suggests, therefore, that the nitrogen contained in 20 pounds of 7-7-7 fertilizer was the maximum these trees could use under the conditions of this experiment.

Observation of the male flowers showed that even without treatment the amount of pollen produced was sufficient to fertilize all female flowers present. Variation in catkin crop between trees was large but no trends were evident.

A second count of the female flowers in the spring of 1956 was based on branches cut from the same whorl as in the previous year. The data from this count were tabulated and analyzed in the manner described above. The number of flowers per bud for all treatments was significantly smaller than that of the year before (Table 3). Analysis of variance of the second count showed that the effect of fertilization persisted (5 percent level of significance) and the effect of girdling became more pronounced (1 percent level). Type of fertilizer had no significant effect during the second year.

Discussion

Results from these two studies indicate that it is possible to induce slash pine saplings to flower prematurely, and to increase the flower crop of cone-bearing slash pine trees considerably. Root pruning, girdling, and fertilization proved to be effective treatments for 7-year-old saplings. On 21-year-old cone-bearing trees, application of 20 pounds of 7-7-7 fertilizer per tree raised the flower crop 120 percent; girdling increased it 70 percent. Combined fertilizing and girdling resulted in 180 percent more female flowers. Similar percentage differences were noted a year later, although the number of flowers per bud had dropped considerably for all treatments.

Although partial girdling gave good results, the treatment encouraged insect attack on the younger slash pine trees. A number became infested with the larvae of a pitch moth (*Dioryctria* spp.) which fed along the edges of the wound, causing a copious flow of gum. Pruned roots apparently did not attract insects or facilitate fungus attack; consequently, root pruning, which is also easy to apply to the widely spaced trees in a seed orchard, may prove more useful than girdling.

Since trees in actual seed orchards and seed production areas are widely spaced, a broadcast application of fertilizer would be wasteful. It is therefore recommended that trees be individually fertilized, with amounts adjusted to age, diameter, or crown projection.

Although the results obtained in these studies were encouraging, they should be regarded as indicative rather than conclusive. Because the natural factors affecting flower-bud formation vary from year to year, somewhat different results might be obtained in other years. Some of the injury treatments, particularly strangulation, may require more than one year to exert their full effect. Further study of the use of fertilizers is also needed. Soil analyses could be made to determine what mineral nutrients are already available; the three major elements could be tested singly and in pairs; and the more successful nitrogen dosage should be confirmed by other tests.

Summary

Methods for stimulating early and abundant flowering were tested in two studies on 7- and 21-year-old slash pine trees located on light sandy soils in north Florida.

On 7-year-old trees, root pruning, stem injury, and application of 5 pounds of 3-12-6 fertilizer per tree increased the number of trees which bore female flowers as compared to untreated trees. In the stem injury treatments, partial girdling was more effective than strangling by wire.

On 21-year-old trees, partial girdling increased the number of female flowers. Of two types of fertilizer tested in this age class, 20 pounds per tree of a 7-7-7 mixture stimulated flowering, whereas the same dosage of a 3-18-6 mixture had no effect. Doubling the application to 40 pounds per tree showed no additional effect with the 7-7-7 fertilizer, but increased the flower crop with the 3-18-6 mixture.

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Outdoor Cooking Helps Sustain Charcoal Industry

Popularity of modern day outdoor cookery is helping to sustain one of the nation's oldest industries. Charcoal production in the United States amounted to 265,000 tons in 1956, the U. S. Department of Agriculture has announced. This was somewhat above production in other post-war years, but less than half the reported peak production of 555,000 tons in 1909.

About half the charcoal produced in 1956 was used—largely in the form of briquettes—for picnics, outdoor cooking, and by restaurants and dining cars. Some 35 to 40 percent was used in the chemical and metal industries. The rest was used for miscellaneous purposes such as curing tobacco, poultry feed, and water purification.

The report shows that 194 of the 240 known charcoal producers were located in the East where 98 percent of the charcoal produced was manufactured. California, with 39 producers, was the only western state with a well-established charcoal industry.

About 574,000 cords of wood were used in charcoal manufacture in 1956, an average of 2.2 cords per ton to charcoal produced. Hardwoods such as oak, hickory, birch, beech, and maple accounted for 92 percent of the wood consumed and softwoods—chiefy pine—the remainder.

Seventy-four percent of the wood consumed in 1956 consisted of roundwood cut directly from trees. The rest came from residues such as slabs and edgings from primary wood manufacturing plants.

A copy of the report, "Charcoal Production in the United States," may be obtained from the Forest Service, U. S. Department of Agriculture, Washington 25, D. C.

Factors Affecting Local Control of White Pine Blister Rust in Minnesota[1]

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U. S. Department of Agriculture

WHITE PINE BLISTER RUST, caused by *Cronartium ribicola* Fischer, first found on eastern white pine (*Pinus strobus* L.) in Minnesota near Taylor's Falls in 1916, is now prevalent throughout the white-pine-growing area of the state. Because the rust requires *Ribes* spp. as an alternate host to complete its life cycle, the disease is controlled primarily by eradicating Ribes near the pine. As many as three separate eradications at 3- to 5-year intervals are usually required for effective control. Elimination of diseased trees or their infected parts by pruning has also been considered as a possible aid to control.

Method of Study

From 1933 to 1940, eastern white pines were planted by federal and state agencies throughout northern Minnesota, for the most part on sites with low Ribes populations, but without regard to the natural development and succession of Ribes growth following fires. When heavy rust damage was found on plantations following eradication of Ribes in previously burned-over areas, it was apparent that on certain sites the rust could not be controlled by eradication of Ribes bushes. To determine the cause of such failure, two areas in the Superior National Forest which had burned over, one 2 years and the other 26 years before planting, were studied to compare the results of Ribes eradication under the respective conditions.

Because of high initial investment, maintenance, and possible need for replanting rust-damaged areas, the possibility of saving many trees by elimination of tree cankers was considered. To test the feasibility of this means of supplementing disease control, cankers were cut out of young forest plantation trees on the Quetico-Superior Wilderness Research Center.

Rust damage was found to be prevalent also in natural sapling and pole-size stands from which Ribes had been eradicated in the Cloquet Valley State Forest, where an average of 52 percent of the trees were already infected when bushes were removed. Therefore, in a second experiment, diseased limbs were pruned from natural forest trees to supplement control methods.

Effectiveness of Ribes eradication in relation to fire history.—Re-establishment of Ribes from seed is a major factor in preventing effective and economical control of the rust. Following fire, Ribes seedlings originate principally from seed stored under the duff and humus near the mineral soil, at some time during establishment of the forest cover just destroyed. According to Davis and Moss,[3] Ribes seeds are not readily permeable to air and water and remain dormant until environmental factors break the resistance of their hard seed coat. As the canopy of the forest stand closes, Ribes and most other shrubs and ground-cover plants are suppressed and gradually die. Germination of Ribes seed practically ceases, and the few seedlings which do appear fail to survive.

From 1935 to 1940, two burned-over areas in the Superior National Forest were planted to eastern white pine: the Gunflint Lake Plantations in northwestern Cook County, and the Markham-Palo Plantations about 95 miles to the southwest in St. Louis County. The white pines were planted at about the same time, and approximately the same number of Ribes bushes per acre were initially removed after about the same time interval. The Gunflint area was burned in 1910, 26 years before planting; and the Markham-Palo area was burned in 1936, 1 to 2 years before planting. In 1947 the author began to study factors influencing growth and development of Ribes, spread of rust, and effectiveness of Ribes eradication on these 2 areas.

An old burn.—An area of about 2,000 acres of upland flats lying between Gunflint and North Lakes was logged from 1901 to 1909, and in 1910 an intense fire swept over the logged-over part, but no subsequent fire is on record. The author examined the area in 1936 and found no evidence of a fire since the 1910 burn. In 1936, the year the first white pines were planted, the timber cover type was a thin stand of sapling and pole-size aspen (*Populus tremuloides* Michx.), white birch (*Betula papyrifera* [Marsh.] Spach.), balsam fir (*Abies balsamea* [L.] Mill.), and about 50 trees per acre of natural eastern white pine and red pine (*Pinus resinosa* Ait.) reproduction in the understory.

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[1]Paper No. 3722, Scientific Journal Series, Minnesota Agricultural Experiment Station.

Part of a thesis submitted to the faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the Ph.D. degree.

The investigations dealing with canker pruning in young forest plantations were made possible through the cooperation of the Quetico-Superior Wilderness Research Center, Ely, Minn.

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[3]Davis, Kenneth P., and Virgil D. Moss. Blister rust control in management of western white pine. Nor. Rocky Mt. For. and Rge. Expt. Sta., Missoula, Mont. U. S. For. Serv. Sta. Paper 3. 1940.

An average of 58 Ribes per acre was eradicated on an area of 668 acres during the period of 1936 to 1938 (Table 1). In 1949, 12 years later, the upland types were essentially free of Ribes growth. The only bushes observed were found within or bordering swamp types; and 6.4 percent of 1,328 trees examined had blister rust cankers (Table 2). The oldest infection was found on 1938 wood, and 1946 growth had the youngest visible infection. The greatest number of cankers was on 1943 growth (Fig. 1).

The new burn.—In 1936, a devastating fire known as the Markham-Palo fire burned an area of over 50,000 acres in and near the Superior National Forest. During the period of 1937-40, approximately 2 million eastern white pine trees were planted on about 1,888 burned-over acres. This severe fire consumed most of the organic matter in the soil and exposed the mineral soil and shallow bed-rock surface over nearly all the burned area.

An average of 57 Ribes per acre was initially eradicated on an area of over 5,000 acres. Due to regrowth of bushes subsequent to the initial eradication, some areas were cleared of Ribes two and three times. Over eight times as many bushes were removed on one area the second time as were found the first. Twelve years after the eradication program had been in progress, 44 percent of about 7,000 trees examined had blister rust cankers, and 56 percent of these rusted trees had already been killed or were dying. Cankered trees were uniformly distributed throughout the plantations and no evidence of rust intensification was observed near swamps containing higher concentrations of Ribes than on upland areas.

The oldest infection was found on 1937 growth and the youngest on 1946 wood. Of 1,652 cankers examined (Fig. 1), 640 cankers or 39 percent were found on 1944 growth, the peak for rust prevalence. The year 1943 was next in prevalence, with 489 cankers or 30 percent of the total on wood produced that year.

TABLE 1.—COMPARISON OF RIBES REMOVED ON AN OLD WITH A RECENT BURN

Location	Number of Ribes bushes pulled			
	First eradication		Second and third eradication	
	Total	Per acre	Total	Per acre
GUNFLINT L. (Old burn)				
Area 1	9,170	63		
2	16,940	67		None
3	12,501	46		
Total	38,611	Average 58		
MARKHAM-PALO (Recent burn)				
Area 1	113,441	70	52,621	26
2	106,058	51	129,179	63
3	7,103	10	30,928	85
4	58,002	94	93,979	225
Total	284,604	Average 57	Total 306,707	Average 59

TABLE 2.—NUMBER AND PERCENTAGE OF TREES WITH RUST ON AN OLD COMPARED TO A RECENT BURN (1948-49)

Location	Plot acres	Ave. no. of pines examined per acre	Pines with rust		Percentage of pines with rust
			Living	Killed[1]	
GUNFLINT L. (Old burn)					
Area 1	0.40	338	7	1	5.9
2	1.28	433	35	1	6.5
3	1.08	594	38	3	6.4
Total	2.76		80	5	
Average		481			6.4
MARKHAM-PALO (Recent burn)					
Area 1	4.38	452	178	383	28.3
2	5.65	695	825	1,112	49.3
3	0.80	520	17	98	27.6
4	0.98	629	287	129	67.5
Total	11.81		1,307	1,722	
Average		588			43.6

[1]Includes living trees with cankers on main stem.

Weather records.—Weather conditions were very favorable in northeastern Minnesota for spread and development of the disease especially during years 1942, 1943, and 1944, the same 3-year period of high canker frequency on both the old and new burn. A study was made of the weather records for July, August, and September. The number of continuous periods (15 hours or more) of relative humidity at 90 percent or higher and the mean temperature at 8:00 AM were tabulated for 1937-46. In 1942, there was an 18-hour period the first of August and a 24-hour one the latter part of the month. There were three periods in 1943: an 18-hour period the middle of July, a 15-hour period in August, and an 18-hour one the first part of September. Six periods were recorded in 1944: two of 15 hours, one of 48, and one of 24 hours in July; one of 15 hours the first and one of 48 hours the latter part of August. The 48-hour period for August in 1944 was the longest continuous record for this month in the 10-year span.

Mean air temperature during the same 3-year period of high canker frequency ranged from 62°F. in 1942 to 63°F. in both 1943 and 1944.

Canker elimination in forest plantings.—Beginning in 1948 at the Quetico-Superior Wilderness Research Center canker elimination studies were made in a 100-acre plantation which comprised

FIG. 1.—Percentage of total cankers according to approximate year of origin.

principally eastern white pine, red pine, and white spruce. The Ribes growth was cleared from the plantation and within a border strip up to 900 feet surrounding the planted area. To eliminate cankers from young trees 12 feet and less in height, infected branches were cut off where the canker margin was 6 inches from the trunk (branch pruning); where a canker was nearer the trunk, branches were removed and the bark around the stub excised (branch-trunk pruning); where a canker was on an upper main stem, the top of the tree was lopped off 6.1 inches or more below the canker margin (top pruning).

Results of re-examination 6 years after pruning indicated that 100 percent of the branch-pruned trees were free of rust symptoms. Results of the branch-trunk method were particularly striking, as 68.8 percent of the scars were free of rust symptoms in cases where cuts had been made only 0.1-2.0 inches from the canker margin. Where cuts had been made 2.1-3.0 inches (Fig. 2), 3.1-4.0 inches, and 4.1-6.0 inches from the canker margin, 88.0, 93.5, and 100 percent, respectively, were free of rust symptoms (Table 3) (Fig. 3). Where trees had been top-pruned 6.1 inches or more below the canker margin, 95 percent were canker free.

The cost of the work is an important factor in the practical application of canker elimination. The present investigations have shown that the work can be done at a reasonable cost. The branch type of canker pruning was accomplished at the rate of 227 trees (averaging 10 feet in height) per 8-hour man-day, and cost approximately $0.04 per pruned tree, based on a labor rate of $1.10 per man-hour. According to data compiled in 1949 at the Quetico-Superior Wilderness Research Center, the investment for a tree 10 years old, including cost of planting stock, the planting, protection, and maintenance of the plantation, is $0.50. Thus, a 4-cent charge appears to be justified for a 50-cent investment.

TABLE 3.—DISTANCE BETWEEN CANKER MARGIN AND PRUNING WOUND FOR ELIMINATION OF RUST BY THE BRANCH-TRUNK PRUNING METHOD

Distance between canker margin and pruning wound, in inches	Tree height class, in feet				
	0.1-3.0	3.1-6.0	6.1-9.0	9.1-12.0	All heights
	Scars with no rust symptoms after 6 years				
4.1-6.0					
Number	3	40	25	15	83
Percent	100.0	100.0	100.0	100.0	100.0
3.1-4.0					
Number	3	30	16	9	58
Percent	100.0	88.2	100.0	100.0	93.5
2.1-3.0					
Number	5	38	18	5	66
Percent	83.3	92.7	86.0	71.4	88.0
0.1-2.0					
Number	24	55	25	11	115
Percent	70.6	68.8	69.8	70.0	68.8

Pruning a natural forest stand.—A pruning study was made in a 44-acre stand of second-growth white pine in the Cloquet Valley State Forest where Ribes had been eradicated the previous year, at which time the stand averaged 106 healthy trees per acre, 103 infected, and 11 with non-prunable infections. The stand was about 20 years old and was predominantly sapling-size. The trees averaged 2.5 inches d.b.h. and 12 to 15 feet high, with a scattering of larger ones up to 25 feet high and 4 to 6 inches in diameter.

Four 1-acre plots were treated by (1) pathological pruning, removal of diseased limbs only, and (2) a combination of pathological and silvicultural pruning, removal of all lower branches and those with cankers in the upper five whorls (Fig. 4).

Plot I.—Of 227 pines on this plot, 190 trees, spaced about 14 feet apart and averaging 12.5 feet high, were selected as crop trees and given silvicultural pruning. All branches to an average height of 6.8 feet, and branches with cankers above this height, were removed. Twenty-six trees were selected at random to provide data on the pruning operation.

Plot II.—The same type of pruning was used as for Plot I, except that all trees (264) were pruned and no preference was given to selected crop trees. Data were collected from 50 trees picked at random.

Plot III.—Cankered branches were cut from selected crop trees but no further pruning was done. From 313 trees, 212 vigorous ones, spaced about 14 feet apart, were selected. Average height was 14.6 feet. Canker data were tallied from

50 representative trees selected at random.

Plot IV.—As an unpruned check, 50 evenly spaced trees averaging 13 feet high were selected, without regard to presence or absence of cankers, for comparison with those on the other three plots.

After 6 years the combined pathological and silvicultural method was found to be more effective: of 26 trees pruned by this method, 15, or 58 percent, were free of disease symptoms compared with 7, or 37 percent of 19 trees given a pathological pruning only (Fig. 5). Where the combination pruning method was applied to selected crop trees only, 11 of the 37 trees or 30 percent were canker-free after pruning. When no pruning was done (check plot) 9 trees, or 28 percent, recovered through mortality of cankers or death of the cankered limbs from causes other than rust.

Discussion of Results

Comparative effectiveness of Ribes eradication on an old and a recent burn.—Evidence shows that fire history appeared to be a significant factor in local rust control of the two areas studied. Both areas were located on the Superior National Forest; both had been planted to white pine about the same time; and about the same number of bushes on each area were initially eradicated at about the same time. A major difference between the two areas was the length of time that elapsed between the fire and the eradication work.

The Ribes population on the Gunflint Lake area (the old burn) had become static after 26 years, and young seedlings were almost nonexistent. Older, suppressed bushes that survived were confined to openings and semi-permanent brush types in the upland. Larger concentrations of bushes were found in lowlands, especially along swamp borders, where the moisture supply was more stable. The three most prevalent species, *Ribes glandulosum* Grauer., *R. hirtellum* Michx., and *R. triste* Pall., were found in this habitat. One eradication job reduced the Ribes population to a level where rust damage was almost negligible; 12 years afterward, only 6.4 percent of the trees had visible symptoms of rust. This amount of rust damage is normally present in white pine stands of the northern one-third of Minnesota where Ribes bushes have been removed. Since the rust occurs only on scattered trees, this amount of damage is almost negligible during the life of a stand.

Conditions on the Markham-Palo area (the recent burn) were in sharp contrast to those described for the Gunflint Lake area. The greatest regeneration of Ribes occurred on the recent burn from sprouts originating from unburned or partially burned crowns of original bushes and seedlings from stored seed, a peak in the population from the latter source occurring about three years after the fire. Even after the eradication program had been in progress two seasons, seedlings originating from stored seed were many times more numerous than the Ribes population before eradication. Twelve years after the start of the eradication program, an average of 44 percent of the trees were rusted.

The relationship between weather conditions and incidence of rust was studied on both burns. There was a correlation on both areas between continuous periods of high humidity and incidence of cankers in 1942, 1943, and 1944. It is possible that there are differences in local climatic conditions between the two sites studied.

Canker elimination on forest plantations.—Methods of removing cankers in ornamental and forest stands were described by Martin *et al.*[4] in 1942. They recommended that infected branches be cut off at least 4 inches back of the yellowish

[4]Martin, J. F., G. F. Gravatt, and G. B. Posey. Treatment of white pines infected with blister rust. U. S. Dept. of Agric. Farmer's Bul. No. 1885. 1942.

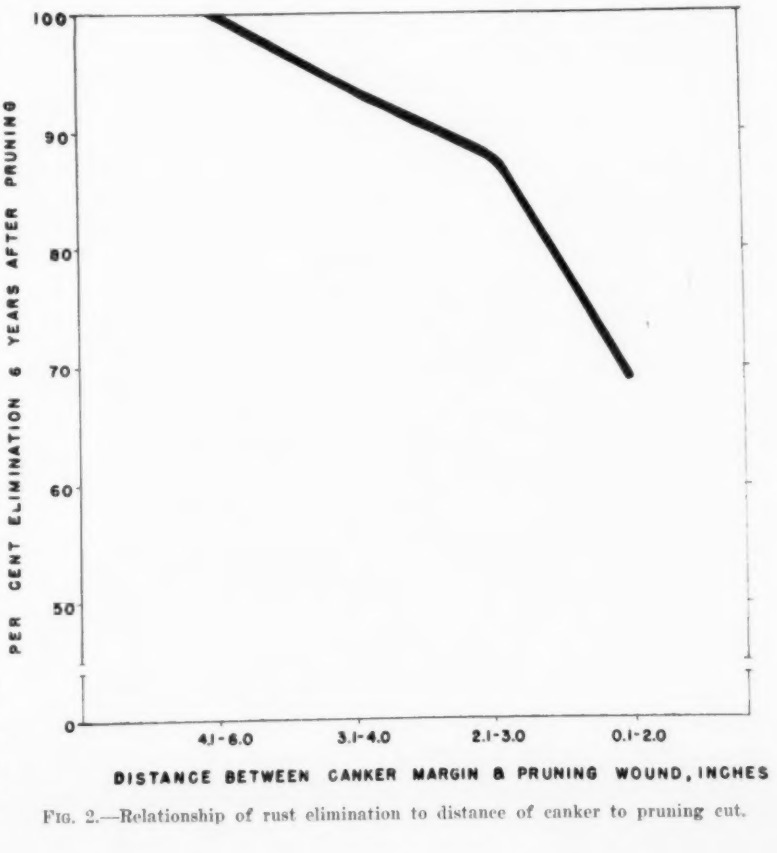

FIG. 2.—Relationship of rust elimination to distance of canker to pruning cut.

edge of the canker; if this was less than 4 inches from the trunk, it was prescribed that the limb be cut off flush with the main stem and that bark be removed for a sufficient distance around the base of the stub to allow 4 inches between margin of canker and edge of pruning wound.

The present investigations have shown that cankers can be effectively and economically removed from young trees by pruning. September and October were found to be a desirable time for this because canker margins were more easily seen on the bark. Control of the rust by canker elimination should follow thorough eradication of Ribes in the vicinity of young pines to prevent their reinfection by the fungus.

Canker pruning in natural forest stands.—One of the principal reasons for missing cankers on a pruning operation is that many cankers are too young to be recognizable. Since Ribes were eradicated only 1 year in advance of pruning, there were many young, nondetectable cankers at the time of pruning. Honey[5] found that the delay between origin and macroscopic recognition of blister-rust cankers was due to indefinite signs and symptoms, only 7 percent of the cankers being recognizable after 1 year, 44.9 percent after 3 years, and 99.4 percent after 7 years. Moreover, many cankers are overlooked since they are difficult to detect because of their height above the ground and the screening effect from neighboring branches. In the younger plantations all branches of the trees were easily accessible, with less foliage to obscure the vision of the pruner.

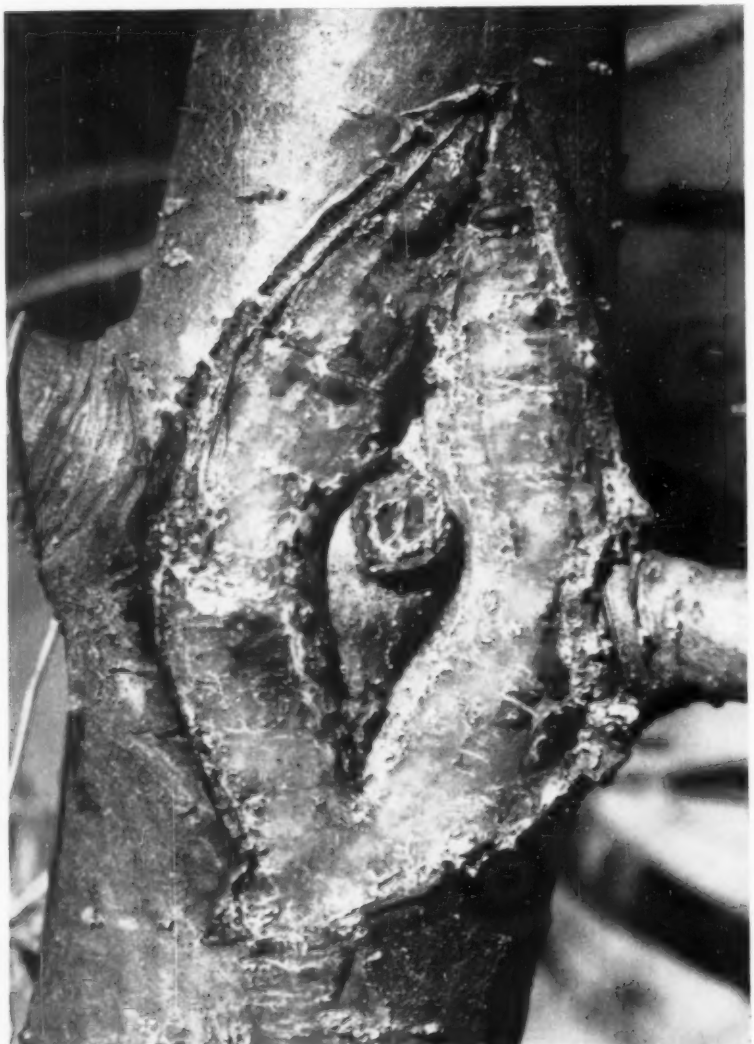

FIG. 3.—A successfully treated 10-year-old tree showing cut stub of cankered lateral branch in center of diamond-shaped pruning wound. Visible canker margin was originally 3 inches from trunk. Photo by courtesy of Quetico-Superior Wilderness Research Center.

Benefits of silvicultural pruning alone were considered; a favorable cost rate was accomplished on a field basis of 103 linear feet of bole pruned per man-hour. This type of pruning also reduces the most favorable target for subsequent infection, as well as eliminating branches which may have incipient cankers that are nondetectable at the time of pruning. However, the full benefit of the first silvicultural pruning cannot be realized without a second pruning scheduled to extend the pruning height to 17 feet, which will provide a clear 16-foot log for the final harvest.

If a second pruning 6 years after the first had been scheduled, it is calculated that an additional 8 trees or 42.1 percent could have been saved on Plot I (silvicultural pruning of crop trees); 4 trees or 15.4 percent on Plot II (silvicultural pruning of all trees); and 5 trees or 13.6 percent on Plot III (pruning of cankered branches only). An examination of Plot IV (unpruned check) in 1951 revealed that only 6 trees or 18.8 percent of the trees with blister rust cankers could be saved by pruning (Fig. 5). If the 1945 pruning had been postponed for 6 years, it is estimated that only about one-third the number of trees could have been saved.

It is apparent that the silvicultural type of pruning was more effective than pathological pruning

[5]Honey, Edwin E. White pine blister rust control. Nor. Cent. Reg. Ann. Rpt., U. S. Dept. Agric., Bur. Ent. and Pl. Quar. (Dittoed). 1941.

FIG. 4.—Sapling white pine stand in 1945 just after completion of pruning. Cloquet Valley State Forest.

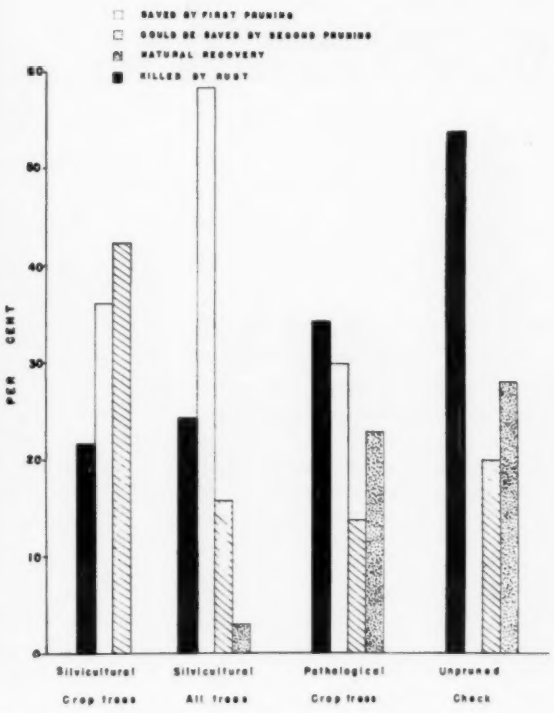

FIG. 5.—Effectiveness of pruning under different stand treatments.

in number of trees saved and other benefits derived from pruning. The silvicultural method of pruning should be considered for well-stocked stands only and where removal of Ribes is economically feasible. It is doubtful if this type of pruning can be justified as a practical forest operation in a poorly stocked stand as heavily rusted as this particular area in the Cloquet Valley State Forest. The stand is subject to further rust damage and natural losses before maturity. Owing to regrowth of Ribes, two additional eradications spaced 3 to 5 years apart may be required to prevent infection of healthy trees and reinfection of pruned trees. The values are marginal and the risk from further rust damage too great.

Summary

In northern Minnesota on one area burned over 26 years prior to planting to white pine, blister rust was effectively controlled by one eradication of Ribes.

On a second area, burned over 1 to 2 years before planting, control by eradication was ineffective because of continual regeneration of Ribes beginning within 1 year after the fire. After attempted eradication of bushes, 67.5 percent of the trees on one site had cankers.

The elapsed time between fire and planting of white pine is an important factor in the control of rust, and neither the planting of pines nor eradication of Ribes bushes is advisable on recently burned areas where site conditions are otherwise favorable for Ribes growth.

To eliminate cankers from young planted trees, infected trees were pruned in three different ways: (1) where canker margin was 6 inches from trunk, entire branches were cut off; (2) where canker was nearer trunk, branches were removed and bark around branch stub excised; (3) where canker was on upper main stem, the top of tree was lopped off below canker margin. Reexamination 6 years after pruning indicated 100 percent of the trees that had been branch pruned, 69-100 percent of the trees with branch-trunk pruning scars, and 95 percent of the top-pruned trees were canker free.

Canker elimination was attempted on natural forest trees by (1) removal of diseased limbs only (pathological) and (2) removal of all lower branches and those with cankers in the upper five whorls (combination of pathological and silvicultural). Examination after 6 years indicated the second method was more effective but questionable as a forest operation.

On certain sites where Ribes can be effectively and economically removed, supplemental elimination of cankers in young plantings is advisable to insure well-stocked stands. Likewise, in young well-stocked natural stands of high value from which Ribes can be removed at a reasonable cost, pruning is a feasible operation to save additional trees and to derive silvicultural benefits.

Noncommercial Thinning of Stagnated Jack Pine Stands and Losses Attributable to Bark Beetles[1]

John A. Schenk,[2] Robert C. Dosen,[3] and Daniel M. Benjamin[4]

JACK PINE (*Pinus banksiana* Lamb.) is one of the major trees used for paper pulp in Wisconsin. Typically, this species forms dense, pure, even-aged stands with excessive reproduction. It also has been planted extensively because of its rapid growth and pulping characteristics. Stagnation is common early in the life of the forest, and periodic thinnings are required to relieve this condition. The timing of thinnings to avoid insect population increase in the slash and the treatment of the slash itself have been in controversy for many years. Managers of commercial forests in North America are divided in their opinions concerning the importance of slash to the welfare of the forest. One group, citing the works of Chamberlin (*2*), Hopping (*7*), and Swaine(*8*), is convinced that all slash resulting from logging or thinning operations should be disposed of because it constitutes a potential breeding area for insects and presents a fire hazard. The other group, referencing studies of Craighead (*3*), and Graham (*5*), is equally adamant in the view that disposal is not economically feasible and that use of fire in disposal actually attracts dangerous insects.

The primary objective of the experiments described here was to determine whether noncommercial thinning could be conducted in stagnating jack pine stands in central Wisconsin during the summer months with a *laissez faire* attitude towards the slash without suffering an economic, barkbeetle-caused loss in the residual stand. Such losses were reported by Stoeckeler in 1949.[5] It was necessary to determine the periods of greatest bark beetle flight and the intensity of attack in the slash in order to correlate these with injury to standing trees.

Description of Test Areas

Two jack pine types were selected in which to investigate the influence of thinning on bark beetle attack in slash and the residual stand of trees. One stand was a plantation and the other a natural forest; both were located 14 miles south of Wisconsin Rapids, Wisconsin, in close proximity to each other on lands managed by the Nekoosa-Edwards Paper Company.

The plantation of approximately 80 acres was established during the spring of 1939 at an estimated density of 2,700 trees per acre. Most of this stand was composed of jack pine, although red pine (*Pinus resinosa* Ait.) was planted in scattered patches throughout the area. Scotch pine (*P. sylvestris* L.) which was planted occasionally, was in poor condition because of infestation by root-collar weevils. The diameters of the jack and red pines ranged from 1 to 4 inches d.b.h., with the dominants and codominants reaching an average height of 16 to 18 feet. A sample strip through an unthinned portion of the plantation served as the check.

The natural stand of the same area as the plantation, was composed chiefly of jack pine, but northern pin oak (*Quercus ellipsoidalis* E. J. Hill) had invaded the site to a considerable extent. In the adjacent section in which the control plot was located, J. H. Stoeckeler[6] determined the average d.b.h. of dominant trees to be 5.3 inches and the average height as 29.1 feet at 28.1 years. Increment studies showed an average radial growth of 1.87 inches during a 20-year period and only 0.92 during the following ten years, thus demonstrating the degree of stagnation.

Procedure

In the plantation, a 30 percent thinning was made in 1954, with cutting commencing in April and continuing until August. Felled trees were allowed to remain on the ground. At the start of the operation, a strip varying from 330 to 396 feet wide was thinned each week. In the more open portions of the stand, only the pines which showed excessive deformities were removed. Oaks which had invaded the site were cut. No conscious effort was made to cut only unhealthy or suppressed trees and, in some instances, as many as four or five trees were removed in succession along one row. Periodically,

[1]This project was supported in part by the Nekoosa-Edwards Foundation, Inc. of the Nekoosa-Edwards Paper Company. The writers acknowledge with sincerity this aid and wish to express their appreciation for the assistance rendered by company foresters. Approved for publication by the director of the Wisconsin Agricultural Experiment Station.

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[3]Forester, Nekoosa-Edwards Paper Co.

[4]Associate professor, Department of Entomology, University of Wisconsin.

[5]Unpublished data from files of Lake States Forest Expt. Sta., St. Paul, Minn.

[6]Unpublished data from files of the Nekoosa-Edwards Paper Co., Port Edwards, Wis.

standing trees on each thinned strip were examined for evidence of bark beetle infestation. In September a final damage appraisal was made. No systematic sampling of the slash was conducted in the plantation because the infestation by bark beetles was exceedingly light. Examination in the fall of 1955 showed that decomposition was well progressed and the cambium dry.

During the 1955 season, 50 percent thinnings were conducted in a nearby natural jack pine forest which was approaching stagnation. The stocking was reduced to about 900 trees per acre. Successive 3-acre strips were thinned every ten days throughout the growing season. Ten days after each cut, 10 standing and 10 felled trees were selected at random in each strip and examined thereafter at 10-day intervals to estimate the insect infestation. Twenty standing trees were similarly examined in an adjacent jack pine stand which served as the control area. The infestation in the slash was obtained by recording the number of felled trees infested in each strip. A more comprehensive damage appraisal was made in the "test" and "control" areas, as well as in the plantation, commencing August 10, 1955 and repeated every ten days thereafter until late fall. This was accomplished by recording all standing dead and dying trees on four strips 66 feet in width through the plantation and on each test strip in the natural stand.

The flight periods of bark beetles were determined by using one-foot-square masonite boards which were painted yellow, wrapped with water-proof cellophane and coated with a thin layer of commercial "Tree-Tanglefoot." These were placed in trees at regular intervals along five marked strips through the plantation. A series of trap boards, placed in the same manner in an unthinned portion of a similar, adjacent stand, served as the check. Numbers of bark beetles caught were assessed at weekly intervals to determine major flight periods. Boards painted red, white, green, blue, and black, and prepared in the same manner as the yellow, were tested to determine their attractiveness to bark beetles. The yellow color produced the best results. In addition, a conventional bait tray with its vanes painted yellow and "trap logs" were tested in an attempt to avoid the use of tanglefoot. The former showed some promise as a means of trapping bark beetles but was not as efficient as the yellow boards; the trap logs proved unattractive to the beetles after three weeks.

Results

Plantation—thinned in 1954.—Only one standing tree was observed under attack by Ips in 1954. This was a dominant tree located along a test strip where several trees had been removed as a group. The final damage appraisal, conducted in September 1955, revealed that the loss equaled 0.05 percent in the residual stand. Of the 10 dead and dying trees, two had no indication of bark beetle attack. In the unthinned plantation, the loss was exactly the same as in the thinned area. However, the attacked trees in the unthinned area were of the less desirable classes and would have disappeared before harvest.

Natural stand—thinned in 1955.—The heaviest concentration of bark beetle attack occurred among the June-cut trees where 60 percent of the available slash was infested. A decrease in attack occurred in the subsequent test strips and only 21 percent of the total available slash had been attacked by the end of the season.

Three of 130 standing sample trees were attacked by bark beetles. Of these, one was a suppressed 2.0 inch d.b.h. tree with a badly damaged crown; a second was a 10 inch d.b.h. dominant (wolf) tree which had been under attack for some time. A third tree, a 6 inch d.b.h. apparently healthy dominant, was attacked by only a single beetle late in the season (September 20). No fresh frass was observed during subsequent examinations, and it was assumed that this attack was unsuccessful. The loss in the residual stand due to attack by Ips was 1.5 percent.

Regular examinations of the 20 sample trees in the control plot revealed only one attacked tree—a suppressed, 2-inch tree which had been damaged by snow. This attack was observed on June 30 and neither new frass nor additional attacks on this tree were observed after August 10. The control sample indicated a loss of 5 percent.

The diameters and crown classes of all standing dead and dying trees (a total of 54) on the 13 test strips were recorded during the latter part of the season. Comparison of the average diameters of the attacked trees throughout the study area with the average diameters of the uninfested standing sample trees shows little correlation. No well-defined preference of the bark beetles for trees with certain diameters or crown classes was noted, although suppressed trees accounted for 20 of the 54 trees attacked. Fifteen dominants, 13 codominants, and 6 intermediates were attacked. Many of the dominants observed with bark beetle infestations were decidedly overmature and should actually be classed as "wolf" trees.

Additional areas in the state where summer thinning or logging operations were being conducted were also examined during 1955. On one of these, located in Jackson County, Wisconsin, 10 miles east of Black River Falls, Ips beetles were attacking young jack pine saplings which had sustained logging injuries. None of the large trees of the residual stand were attacked although bark beetle broods infested the larger stumps. Very little slash of the larger diameters was observed on the ground, and much of the stacked wood had been peeled. A second area, also containing jack pine, and located just across the Wisconsin River from the pulpwood yards of the Nekoosa-Edwards Paper Company mill at Nekoosa, Wisconsin, was examined. Here, over 15 percent of the trees were infested with Ips and were either dead or dying.

Another area, located in northwestern Wisconsin about 10 miles east of Solon Springs in Douglas County, where a noncommercial thinning was conducted was examined in 1955. This stand of 42-year-old jack pine was stagnated and in need of release. The trees were generally taller and of larger diameter than those of the study area in the central part of Wisconsin; however, only a few sticks of commercial pulpwood would be obtained from the entire stand. An evaluation of the bark beetle infestation in this area—based upon 10 samples each consisting of 5 standing and 5 felled trees—revealed an average of over 4 out of 5 felled trees quite heavily infested. One standing tree was attacked but the attack was not successful.

Adult Flight Period

The most common bark beetles encountered were *Ips grandicollis* Eichh., *I. chagnoni* Sw., and *I. pini* Say. A few specimens of *Orthotomicus caelatus* Eichh. were collected from a jack pine sapling. During 1954, the first peak of adult movement occurred about July 1. A steady decrease for three subsequent weeks was followed by a second flight peak around August 7. Low counts were common from that date to the end of the season. The number of bark beetles collected in the unthinned strip declined at about the same rate as in the thinned area. After July 1, the adult counts in the unthinned area remained at zero throughout the remainder of the season. In contrast, the presence of the few adults in the thinned area suggests that the slash from the thinnings either had an attractive influence on the bark beetles, drawing them from adjacent areas, or that it produced them by providing a breeding site.

The dates of the high and low periods of adult bark beetle activity coincided fairly well with those obtained by Barrett (*1*) during studies of stored pulpwood. However, it is believed that the spring emergence flight was either delayed until about July 1 by the unseasonable weather, or more probably, that trap boards were placed too late (June 10) to give an indication of the spring flight and that the bark beetles had completed one complete generation.

Evaluation of Associated Weather Conditions

Bark beetle activity is, like that of all other insects, dependent upon the climatic phenomena. Of particular importance are temperature and precipitation and their influence on the distribution, numbers of generations per year, extent of brood survival, population of natural enemies, and the effectiveness of disease (*5*). Because of the importance of climate in the build-up of bark beetle populations, an analysis of temperature and precipitation records over a period of 10 years preceding the thinning study was made. Temperature and precipitation information was obtained from "Climatological Data of the United States—Wisconsin Section," employing the data from the Wisconsin Rapids Station. Although the rainfall and temperature variations at this reporting station probably differ from those at the site of the experiment, the proportionate changes in one area would provide a fair indication of weather conditions and variations in the latter, 14 miles distant.

The two years (1952-1953) preceding the initiation of this study were comparatively dry with temperatures slightly above normal. This was particularly true for the spring and summer months of 1953 when drought conditions prevailed. These circumstances suggest that 1954 might be considered a dangerous season in which to conduct a thinning of a noncommercial nature since the bark beetles had two years of dry weather to increase their numbers. However, wet and cold conditions prevailed during the spring and summer of 1954—especially during the spring when the bark beetles become active after overwintering. This cold and wet spring may have exerted an influence and, with other factors, may account for the unexpected low numbers of beetles trapped on the boards that year and the light attack in the slash.

In contrast, 1955 was a very hot year with serious drought conditions common during the latter part of the summer throughout much of the area. Although precipitation was slightly above normal during the spring months, temperatures averaged over 5 degrees above normal. The summer months produced conditions expected to favor the rapid development and increase of the bark beetles. In addition to the ideal climatic conditions, great quantities of favorable breeding site were present in the form of slash. Despite such favorable conditions, losses to the residual stands were low. It should be pointed out that fresh slash was being made available, and this may have been an important factor.

Conclusions

Although slash serves as a breeding site for the potentially injurious species of bark beetles, no economic loss could be attributed to them in the residual stand following the thinning of natural stands and plantations. The losses revealed in this study differed slightly from those reported by Stoeckeler in 1949[7] who found that July power saw thinning resulted in an average loss of 1.36 percent as compared to 0.75 percent in the check. Although he found the smaller diameter classes more frequently infested, no well-defined preference of bark beetles for any particular diameter or crown class was noted in the current study. It is postulated that the success or failure of thinnings of a noncommercial nature could hinge to a great extent on the conditions of temperature and rainfall during a period of years preceding, during, and following thinning operations.

Company foresters consider mechanical thinning of jack pine stands nearing or at the point of stagnation economically feasible by the use of gasoline powered circular saws mounted on wheels and the smaller, shoulder-slung "Brushmasters," or similar equipment (*4*).

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[7] Loc. cite.

Summary

Experimental, noncommercial thinnings were conducted in stagnant jack pine stands on the sand plains of central Wisconsin to determine whether bark beetle populations would increase to dangerous levels in the slash and then attack the residual stand. A 30 percent thinning was made in a 16-year old plantation in 1954, and 50 percent cut conducted in a 28-year old natural stand in 1955.

Peaks of bark beetle activity in 1954 were found to be July 1 and August 7, by means of trap boards examined at weekly intervals. A damage appraisal of the plantation a year after the thinning showed the loss to the residual stand to be 0.05 percent, which coincided with that in the control plot. Attack of the slash was negligible.

A maximum of 60 percent of the slash in the natural stand was attacked, although only 21 percent of the total available slash at the end of the season had been infested. The residual stand suffered a loss of 1.5 percent; the loss in the control area averaged 5 percent. Under circumstances of this experiment, thinning did not result in any economic loss to the natural residual stands. The greater loss suffered in the control plot may be attributed to the removal of a large portion of the suppressed and damaged trees from the test plot.

An analysis of the weather records for a 10-year period indicated that temperature and rainfall might have an important role in determining insect populations and the resultant threat to stands left after thinning.

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Every Seedling from Selected Seed[1]

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The author describes in the following article the practical and large scale efforts of his company to attain improved quality in future timber stands through the application of tree improvement measures.

THE LARGEST planting of trees from selected seed in this country was made during the past 1956-57 planting season when West Virginia Pulp and Paper Company planted 11 million loblolly and slash pine seedlings on its timberlands in South Carolina and Georgia—all produced by seed from selected trees. The collection of seed only from trees of good form and growth is the first important step in a program to improve the genetic and physiologic quality of planting stock. Further than this, the company's program also includes careful extraction and grading of seed according to size, the establishment of a 20 million seedling capacity company nursery, development of a seed orchard of superior clones, and breeding for special characteristics.

Seed Collection

Most of the seed for this past season's planting was obtained from seed collection areas[3] in plus stands. Seed collection areas are developed by cutting all but the best trees in the best stands available. In the third and fourth growing seasons after the cut a bumper crop of cones is borne as a result of the release from close competition. Seed harvested from these trees is above average in genetic quality because the maternal parents are all above average and a great majority of the pollination is probably from trees in this superior stand. Because a poor cone crop was expected in 1956, it was necessary to collect a two-year seed supply in the fall of 1955. Seed collection areas scheduled for cutting at that time could not supply all of this, so some cones were collected from seed trees in reproduction stands—but only from selected trees. The seedlings were grown at the South Carolina State Nursery.

FIG. 1.—Portion of a loblolly pine seed collection area, developed by cutting all but the best trees in the best stand available.

Collection of slash and loblolly pine seed only from selected trees is now the established policy of the West Virginia Pulp and Paper Company. The principle has also been extended to Atlantic white-cedar where seed collection areas produce the same benefits as in pine: desirable parentage, abundant and large cones, and large seed of high viability. In the future, pond pine and cypress seed will also be produced in seed collection areas.

Extraction and Grading of Seed

The first major step in the practical application of forest genetics has been accomplished by collecting seed only from selected trees. It would be wasteful to lose the value of this step through mediocre nursery practice, and the even greater value of seed from orchards in years to come will make it even more imperative to get as many plantable seedlings as possible from every bushel of cones.

It has been demonstrated that the harvesting of well ripened cones and careful extraction can produce twice the yield of seed per bushel of cones commonly obtained, and at no extra cost. Viability of seed from collection areas has been found to be about 50 percent above average. Thus, application of present knowledge can yield three times the number of plantable seedlings per bushel of cones obtained under common practices.

Light sowing in the nursery should result in few culls. The seed

[1]Adapted from a paper presented at the Southern Forest Tree Improvement Conference, January 9, 1957.

[2]A 20,000 acre experimental forest near Georgetown, S. C.

[3]Easley, L. T. Loblolly pine seed production areas. Jour. Forestry 52:672-673. 1954.

resource can probably be stretched even further by dividing the seed into several sizes. Small seeds produce seedlings which cannot compete in the nursery bed with the larger seedlings from large seed, but in all other respects the small ones are just as good. By sorting seed into several sizes and planting each separately, a larger proportion of the seed should produce plantable seedlings.

Recently one lot of loblolly pine seed was divided into three sizes on a Crippen 3-screen seed cleaner. The small seed numbered 23,600 per pound, medium seed 19,300 per pound, large seed 16,300 per pound. Of the total number of seeds, 29 percent were small, 55 percent medium, and 16 percent large. The optimum breakdown is not known and will have to be determined by experiment. The number of seed per pound and screen sizes used to get this breakdown will vary from year to year with the quality of the seed crop. These figures are cited only as an example of the type of size breakdown that can be obtained.

Orchards of Superior Clones

Selection of seed for genetic quality is a big step forward in forest management. However, there are all degrees of selection of trees and seed. Much more rigid selection than that applied in seed collection areas is possible, so we have really only taken the first step in tree improvement. The next step is to produce seed from orchards of rigidly selected clones. To this end the process of selecting and testing superior trees has begun at Westvaco and techniques of vegetative propagation are being studied. With the assistance of the North Carolina State College Tree Improvement Project, selections of clones to be used in seed orchards are now being made.

Breeding for Specific Qualities

Even seed orchards of rigidly selected clones are only an intermediate application of genetics in forestry. A further application, perhaps the ultimate, is breeding for specific characteristics of wood structure, site adaptability, and resistance to insects and disease. This objective has been pursued in a limited program of controled pollination at Westvaco since February 1954. Several hybrids within species and between species are now one year old in the nursery. The characteristics of one cross are distinct enough to report. Slash pollen on longleaf strobili produced 24 seedlings of which 15 have stems from 1 inch to 4 inches long the first year. The other nine are still in the grass stage. Most needles are as long as longleaf but are more delicate than either slash or longleaf. The most successful interspecies hybrid in terms of number of cones successfully pollinated and seedlings produced was loblolly pollen on pond pine. If this cross combines the site adaptability of pond pine and the growth and form of loblolly it may be ideal for planting in the pocosin country of eastern North Carolina. Of course the evaluation of the useful properties of these hybrids will take many years. This is all the more reason for beginning now.

Results of Seed Selection

How much genetic improvement can we expect from seed selection? It will also take years to answer this question, but meanwhile one guide to an estimate is suggested. The deterioration of a stand following a high-grading cut is well known. The standards of selection used in West Virginia Pulp and Paper Company's seed collection areas are such that the practice should be considerably more eugenic than high-grading is disgenic. By this means the pendulum of change in genetic quality which was swung to the poor side through years of high grading, can probably be swung back more than halfway.

Notes

A Seed Key for Five Northeastern Birches

In a recent study of forest reproduction, a problem arose: how to distinguish among the nutlets or seeds of five birch species native to the Northeast. Available literature provided some information, but not in sufficient detail to permit easy identification; so nutlets from the five birch species were collected and studied to determine what characteristics could best be used for identification purposes. The species are:

Betula alleghaniensis Britton—Yellow birch

Betula lenta L.—Sweet birch (black)

Betula nigra L.—River birch

Betula papyrifera Marsh—Paper birch

Betula populifolia Marsh—Gray birch

To assist other workers who may have an interest in identifying the seed of these northeastern birch species, nutlets of the five species studied are illustrated in Figure 1, and the following identification key has been prepared.

1. Nutlet or seed oval in shape, wings broader than nutlet 2
1. Nutlet or seed not oval in shape, wings narrower than nutlet 3
    2. Wings and nutlet glabrous, nutlet less than twice as long as wide, overall size of nutlet and wings ranges from 1½×2½ mm to 2×3 mm ..... Gray birch
    2. Nutlet finely pubescent towards apex near base of stigmas, wings glabrous, nutlet almost always twice as long as it is wide, overall size of nutlet and wings ranges from 2×3½ mm to 2½×4½ mm ..... Paper birch
3. Nutlet ovate in shape, both wings and nutlet densely pubescent, overall size of wings and nutlet ranges from 4×6 mm to 4½×7 mm ..... River birch
3. Nutlet obovate in shape, wings and nutlet glabrous or sparsely ciliate 4
    4. Wings and nutlet both sparsely ciliate towards apex

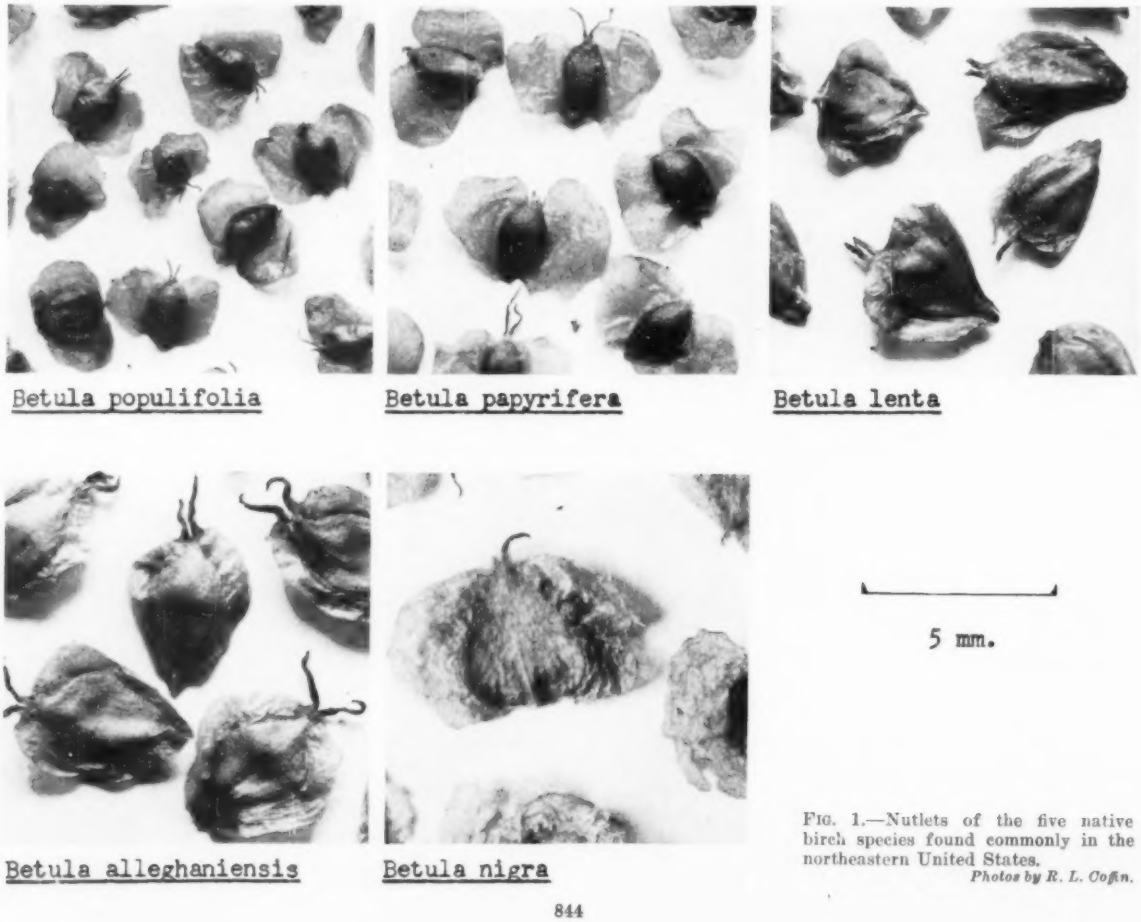

FIG. 1.—Nutlets of the five native birch species found commonly in the northeastern United States.
Photos by R. L. Coffin.

near base of stigmas, overall size of wings and nutlet ranges from 2½×4 mm to 4×4½ mm ..... Yellow birch

4. Wings glabrous, nutlet sparsely ciliate towards apex near base of stigmas, overall size of nutlet and wings ranges from 2×3 mm to 3½×4 mm ..... Sweet birch

This key has been used successfully for distinguishing the seeds of the different northeastern birch species.

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Wood Rats Damage Young Douglas-Fir

During the past two years occasional reports have reached the School of Forestry of gnawed and girdled Douglas-fir, principally in the 15 to 30 year age class. Reports thus far indicate that Douglas-fir is the principal victim although scattered white fir (*Abies grandis*) have been reported damaged. Porcupines were suspected, although this animal is not numerous in northwestern Oregon.

During the summer of 1956, a combined thinning, pruning, and hardwood girdling project was started in such a stand on the School's McDonald Forest, near Corvallis. Dominant trees in this stand averaged 22 years of age and 40-45 feet in height. Numerous stick and twig nests of the dusky-footed wood rat (*Neotoma fuscipes*) were observed in the stand before work was started. Some of these nests were on the ground—others in the trees. These nests varied from three to five feet in diameter and from three to four or more feet in height and were noted where the tree stands were most dense.

The rats are light brown, with a body length of 7½ to 9 inches and a sparsely haired tail averaging 6½ to 8½ inches. Damage is not readily apparent from the ground before the trees are felled.

On a ½-acre plot a count was made of trees 2 inches d.b.h. and over, before and after thinning. There were 360 trees, ranging from 2 to 11 inches d.b.h., and mostly in the 3 to 7 inch classes prior to thinning. Trees removed in this first thinning numbered 136. Of this number, 43.3 percent had been either partially or completely girdled by rats. The rat-girdled trees included a number of dominants originally marked to leave before the crown canopy was opened and damage revealed.

No diameter or crown class group was noted as being especially vulnerable, but the damage was largely confined to the upper third of the tree boles where the bark was most tender. Numerous side branches were also gnawed or completely girdled. Bark was gnawed to the sapwood and toothmarks were often evident. The removed bark, finely shredded, was found in or near the center of the nests, providing a warm inner nest of high insulation material. No bark fragments have thus far been found in a stomach content analysis of captured rats.

Extensive strip surveys, made during the past winter (1956-57) indicate that, in this age class of Douglas-fir, 120 acres on the McDonald Forest and 600 acres on the adjoining Adair Tract, are similarly affected, particularly where the trees are close enough together to enable the rats to jump from one tree crown to another. There has, thus far, been no evidence of rat damage in stands of low density.

An ice storm in late February 1957, has also revealed that many of the tops broken out of trees in this same age class had been previously weakened by older gnawings of the rat, resulting in dead wood at the point of injury.

Control studies made by Don Dickey, a rodent control specialist in Eugene, Oregon, have indicated that poisoning by thallium-treated grain and walnut meats is most effective. The bait is spread around the ground nests and beneath the trees in which nests are found. Since complete coverage of affected areas is necessary to locate the nests, control costs are relatively high—$3.00 per acre—which includes survey, marking of nests, preparation and spreading of bait.

Acknowledgment is made to our forest student summer crew, to the staff and students of the Department of Fish and Game, and to the Don Dickey Rodent Control Company for their cooperation in the investigation and determination of effective measures of controlling this latest menace to young Douglas-fir stands.

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Errata

In the article "Homemade Dendrometers" by Franklin G. Liming in the August issue (Vol. 55, No. 8, 1957) Figure 1 on page 575 and Figure 5 on page 577 were printed upside down.

A Safer Method of Directional Felling Control With The Chain Saw

Since the advent of the chain saw various attempts to improve methods of directional felling have been made. Though still in use, the sledge and wedges are dangerous both to the chain and to the operator, and are a nuisance to carry around and keep track of; a hydraulic wedge developed on the West Coast is too heavy, too costly, and has too little lift for use in eastern and southern timber, and other devices have not caught on because of bulk or inconvenience. Still, directional control of felling remains a real safety and economic bottleneck on many operations.

Experiments with a common truck jack and later with a "house jack" have demonstrated that these simple tools have a real value in the field. Though a truck jack of compact design can be used, the most efficient and economical unit tried is the "1½ inch by 6 inch" screw jack with a 12-ton capacity. Although it can be used without modification, slight changes improve its convenience and efficiency. To make these modifications, one side of the bell-shaped base is sawed off in the same vertical plane as the edge of the jack cap, and a plate is welded on to reinforce this side and make it possible to set the jack flush to a vertical face. A similar plate is welded across the open bottom, and "beads" are drawn with welding rod to form a non-slip base. Care must be used in welding malleable cast iron.

In use, the tree is undercut in the conventional manner and the felling cut is started; then a step for the jack pine is made. A cut about 3 inches deep is made as close to the ground as possible, with a similar cut about 10 inches above and parallel to it, and this block is sawed out by boring with the end of the chain saw. This entire operation takes less than a minute. The jack is set into the step so made, a strain is taken on the jack, the saw is re-inserted, and the felling cut completed. With the felling cut completed and the saw in a safe place, the tree can then be jacked over without shock or vibration.

During the entire operation there is no metal in the kerf "following" the chain, and the risk of hitting the jack is negligible. If it is hit, the chain strikes only the flat surface of the base, not the corner of a wedge, and minimum damage can occur to the chain or the operator. The lack of shock or jar is especially important in the case of snags or trees with "widow makers," and the tree is under "micrometer" control at all times.

White oaks up to 24 inches d.b.h. and white pine nearly 30 inches d.b.h. and 90 feet high have been felled against the lean with the 12-ton screw jack, and smaller hardwoods and hemlocks up to 20 inches have been controlled with a 4.5 ton truck jack. The larger jack is advised, however, since in felling against the lean not only weight but a tremendous mechanical advantage must be overcome. The screw jack is cheaper, lighter, and simpler than a comparable hydraulic jack, costing approximately $6.00 for the 12-ton jack before modification. In felling pine it is necessary to use a plate on top of the jack to distribute the pressure over the softwood, but this is not needed on hardwoods. The jack with plate and handle weighs 16 pounds compared to the 17 pounds of a sledge and three wedges needed to do the same job.

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FIG. 1.—Four and one-half ton automobile jack with ratchet. Approximate price: $11.

FIG. 2.—Twelve ton 1½ x 6 inch Simplex screw jack. Cost $6.

Replacement of Chestnut in the Great Smoky Mountains of Tennessee and North Carolina

Prior to 1904, when the chestnut blight (*Endothia parasitica*) was discovered in New York, the American chestnut (*Castanea dentata* (Marsh.) Borkh.) ranged from New England to Georgia, but reached greatest abundance and best form in the Great Smoky Mountains of Tennessee and North Carolina. Being far from the center of spread, chestnuts in the mesic southern Appalachian forests were among the last to be attacked by the blight.

To determine what tree species are replacing chestnut in this previously uninvestigated region, a study was made of 2,569 openings in the forest canopy created by the death of the trees in 79 stands in which chestnut had been a component.

A total of 5,046 trees of 51 species was found. As Table 1 shows, Quercus comprised at least 41 percent of all replacements and was the most abundant genus.

In some stands, especially the mesic cove types, the replacements usually included *Tsuga canadensis*, and often *Liriodendron tulipifera*, *Magnolia fraseri* Walt., *Halesia carolina* var. *monticola*, *Tilia heterophylla* Vent., and *Acer saccharum* Marsh. On the dry slopes and ridges chestnut is usually being replaced by species much more xeric than these.

TABLE 1.—SPECIES REPLACING CHESTNUT IN GREAT SMOKY MOUNTAINS

Species	Proportion of all replacements
	(*Percent*)
Quercus prinus L.	17
Quercus rubra L.	16
Acer rubrum L.	13
Tsuga canadensis (L.) Carr.	6
Halesia carolina var. *monticola* Rehd.	5
Oxydendrum arboreum (L.) DC.	4
Robina pseudoacacia L.	4
Quercus coccinea Muenchh.	4
Liriodendron tulipifera L.	4
Betula lenta L.	3
Quercus alba L.	2
Fagus grandifolia Ehrh.	2
Cornus florida L.	2
Pinus rigida Mill.	2
Quercus velutina Lam.	2
All others	14

Even before the chestnuts were dead, their canopy space began to be filled by expansion of adjacent codominants. Trees that had been suppressed generally took 9 to 15 years to reach maximum yearly growth following release. Increased annual growth began in approximately 1925-26, indicating the arrival date of the fungus in the Great Smokies.

No indication was found that chestnut will "recover," and forest management in areas which once contained chestnut should be so predicated.

The results of this study are in general agreement with those obtained in New England, Pennsylvania, and elsewhere in North Carolina. The taxa most commonly occurring in the former oak-chestnut association were *Castanea dentata*, *Quercus prinus*, *Q. rubra*, *Q. alba*, *Q. coccinea*, *Acer rubrum*, and *Carya* spp. *Carya* was of minor importance in the forests of the Great Smoky Mountains. Because chestnut is being replaced by various species of oak, mainly *Quercus prinus* and *Q. rubra*, it is believed that the former oak-chestnut forest association will eventually develop into an oak-association complex.

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Diameter Growth of Post Oak Best in Sparse Stands[1]

The diameter growth of individual post oaks (*Quercus stellata*) in Robertson County, Texas, was stimulated when most of the stand was removed to favor forage production.

Stands in the post oak type averaging 65 square feet of basal area per acre were compared with stands whose density had been reduced to 39, 26, and 13 square feet per acre. Trees left were sound, well-formed, dominant post oaks, averaging 6.8 inches d.b.h. and ranging from 5 to 10 inches. Other trees were deadened with chemicals applied in frills or as basal sprays.

The annual growth in diameter of wood (excluding bark) during the two years following the thinning is shown in Table 1, which is based on increment cores from 80 trees in each density class.

The negative correlation between residual density and d.b.h. growth was highly significant. It indicates that in this dry area, where growth is slow at best, the trees were able to benefit from thinning to exceptionally sparse densities.

[1]Based on research conducted at A & M College of Texas, College Station, Texas, in connection with requirements for the Ph. D. degree.

TABLE 1.—GROWTH OF POST OAK FOLLOWING VARYING DEGREES OF THINNING

Basal area per acre of residual stand	Average annual d.b.h. growth of wood, excluding bark
(*Sq. ft.*)	(*Inch*)
65 (check)	0.07
39	.07
26	.09
13	.14

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Wyman's School of the Woods

Editor's note.—The following account of a little-known development in early forestry education in America was made available by Helmuth Bay and Richard R. Fenska.

Wyman's School of the Woods was founded by Thomas B. Wyman in 1909, at Munising, Michigan, incorporated in 1911, and operated as a private forestry school until 1917, when it was discontinued due to the effect of the Second World War. The students all enlisted in the 20th U. S. Army Engineers for overseas duty in France.

After graduating from the Biltmore Forest School in North Carolina in 1909, Wyman became forester for the Cleveland Cliffs Iron Company which had extensive timber holdings in the Upper Peninsula of Michigan. His work consisted mainly of marking out their holdings on the ground and obtaining estimates of the stands by volume and species.

When he took over his duties he soon found that he would need the assistance of estimating and surveying crews. Inasmuch as young trained foresters were difficult to obtain, he decided to train his own and thus was born Wyman's School of the Woods. Munising with its surrounding forests and woodusing industries offered special advantages for a school of this kind.

The course was two years in duration. Six months were spent indoors, six months in the field, then another six months in the school rooms, and the final six in the woods. The subjects taught were all forestry, principally dendrology, surveying, mensuration, forest history, and management. Field work included the actual running of section lines and setting corners, stem analysis, estimating timber by various methods, and collecting tree seeds. The tuition was $100 per year.

Wyman himself taught a number of courses while the remainder were handled by Walter W. Gleason, a graduate of Yale (1908) who was also county surveyor of Alger County, Michigan.

On February 25, 1916, Richard R. Fenska, a graduate of the Yale School of Forestry, took charge of both the field and the classroom work, with some assistance from Wyman in the class sessions. Fenska remained with the school until the end, when on September 11, 1917, he left to join the forestry faculty of the University of Montana.

The school had no buildings of its own. Classes were held in several rooms of the Munising High School, as well as in office buildings of the Munising Lumber Company. The last group of students built their own log cabins on the shore of Perch Lake, two miles south of Munising. These served as their individual headquarters while on field work.

A complete record of the students enrolled at this school is not available. During the winter of 1913-1914 there were 26 students. The last class (1917) contained 21 men.

Occupations of Penn State Forestry Graduates

An analysis has been made of the employment in 1957 of alumni of the School of Forestry, The Pennsylvania State University. This analysis is based upon the information that was collected for the publication, *Forestry Education in Pennsylvania*, edited by Henry Clepper, which was published as part of the 50th anniversary celebration of the School of Forestry, held at University Park, May 27-28, 1957.

Some 1,990 men had been graduated from the School of Forestry from 1906 through 1956, including 243 from the old State Forest School at Mont Alto. Of these, accurate returns on current employment were received from 1,265.

Information on these 1,265 graduates has been assembled in Table 1 under three major subdivisions: (1) Graduates employed in forestry; (2) Graduates employed in forestry-related fields; (3) Graduates employed in non-related fields.

The table has been subdivided further into three periods in order to segregate the graduates of the past 10 years from those of the previous 10 years, during which considerable disturbance was experienced in employment from the effects of World War II. This division has left graduates of the first 31 years as a third group that makes an interesting comparison with the more recent periods. The occupations considered were those reported at the time of the collection of the data in the spring of 1957, and not the jobs obtained immediately after graduation.

Certainly, the most important fact brought out by this analysis is that 69 percent of the forestry graduates is currently in forestry occupations. In other words, the professional training given these men is being utilized in the state and nation where alumni are employed as professional foresters. In addition, another 13 percent of the graduates is in forestry-related employment, making a total in forestry and forestry-related employment of 82 percent.

Only 19 percent of the graduates is employed in what may be called non-related employment. Even then it may be said that success in such professions as law, medicine, ministry, and activities such as scouting, are related to the biological and scientific training given the forestry student. The same is true of men engaged in high school or other teaching that it not strictly related to forestry. In fact, it is encouraging to find that the broad general basis of professional forestry training has permitted the graduates to enter successfully into many enterprises

TABLE 1.—THE OCCUPATIONAL DISTRIBUTION IN 1957 OF GRADUATES OF THE SCHOOL OF FORESTRY, THE PENNSYLVANIA STATE UNIVERSITY

Type of employment	Graduates of 1906-1936 (31 years)		Graduates of 1937-1946 (10 years)		Graduates of 1947-1956 (10 years)		Totals	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
Forestry	**297**	**71**	**226**	**64**	**354**	**72**	**877**	**69**
Federal Government	98	23	48	14	105	21	251	20
U. S. Forest Service	80	19	37	10	89	18	206	16
Department of Interior	13	3	9	3	15	3	37	3
Tennessee Valley Authority	5	1	2	1	1	..	8	1
Foreign assignments	3	1	5	1	4	1	12	1
State and City Government	77	18	55	15	83	17	215	17
Pennsylvania Department of Forests and Waters, and Department of Highways	38	9	22	6	56	11	116	9
Pennsylvania Game Commission	5	1	5	1	4	1	14	1
Forestry and conservation departments of other states	30	7	27	8	23	5	80	6
City forestry	4	1	1	..	0	..	5	1
Education	23	6	13	4	39	8	75	6
Private-industry	96	23	105	30	123	25	324	25
Pulp and paper	15	4	26	8	21	4	62	5
Sawmill and lumber	18	4	15	4	26	5	59	4
Other wood using industries	13	3	28	8	42	9	83	7
Consulting and private forestry	44	11	32	9	29	6	105	8
Public utilities, water companies, and railroads	6	1	4	1	5	1	15	1
Forestry-related	**54**	**13**	**47**	**14**	**53**	**11**	**154**	**13**
Federal Government	33	8	21	6	19	4	73	6
Soil Conservation Service	20	5	17	5	6	1	43	3
Other, Department of Agriculture	1	0	1	..	0	..	2	1
Other Federal	12	3	3	1	13	3	28	2
Private-industry (engineering and construction)	17	4	23	7	32	6	72	6
Farming	4	1	3	1	2	1	9	1
Nonrelated	**69**	**16**	**79**	**22**	**86**	**17**	**234**	**18**
Miscellaneous professions	4	1	4	1	6	1	14	1
Education	13	3	10	3	6	1	29	2
Business	43	10	46	13	25	5	114	9
Politics	1	0	0	..	0	..	1	..
Military	8	2	19	5	49	10	76	6
Total	420		352		493		1,265	

Summary	*Number*	*Percent*
Graduates in forestry	877	69
Graduates in forestry-related fields	154	13
Graduates in nonrelated fields	234	18
Total	1,265	100

An explanation follows of the headings used in Table 1

Forestry—employment which involves, in its beginning at least, the training required of a forester in either forest management or wood utilization.

U. S. Forest Service—all positions for which forestry graduates are used.

Department of the Interior—includes Bureau of Land Management, National Park Service, Bureau of Indian Affairs, and Geological Survey.

Tennessee Valley Authority—forestry and land management.

Foreign Assignments—foresters for the United Nations Food and Agriculture Organization, rubber plantation managers, U. S. Department of State.

Pennsylvania Department Forests and Waters—all positions for which forestry graduates are used.

Pennsylvania Department Highways—highway foresters.

Pennsylvania Game Commission—all positions for which forestry graduates are used.

Forestry and conservation departments of other states—all positions for which forestry graduates are used.

City forestry—all positions for which forestry graduates are used.

Education (forestry)—teaching, extension, research personnel, and graduate assistants in forestry.

Pulp and paper—all forestry-trained personnel.

Sawmill and lumber—all forestry-trained personnel.

Other wood-using industries—plywood and veneer, furniture manufacturing, wood preservation, private wood utilization research organizations.

Consulting and private forestry—forestry consultants, foresters for coal, steel, or other industrial corporations not primarily wood-using, private nurserymen.

Public utilities, water companies, railroad—foresters and vegetation managers.

Soil Conservation Service—all forestry-trained personnel.

Other U. S. Department of Agriculture—positions not in U. S. Forest Service or Soil Conservation Service.

Other federal—Weather Bureau, Patent Office, Map Service, Bureau of Ships, Civil Service Commission, U. S. Navy (civilians), Department of Internal Revenue, biologists in military research.

Engineering and construction—industrial engineers, design engineers, construction contractors, and builders.

Farming—farm operator and agriculture businesses.

Miscellaneous professions—law, medicine, ministry, scouting.

Other education—high school, preparatory schools, general administrators in education.

Other business—businesses not involving the use of wood or its products, such as insurance and retail merchandising.

Politics—elected office holders.

Military—mostly career men from World War II and graduates in advanced ROTC.

where the type of analytical thinking developed in a well-rounded technical curriculum has been useful.

The analysis showed, as might be expected, that the U. S. Forest Service is the top employment agency of forestry graduates, accounting for 16 percent of the total. The Pennsylvania Department of Forests and Waters and the Pennsylvania Department of Highways are, together, the second largest employer with 9 percent of the total. It is interesting to note that the graduates of the 1937-1946 period, which was marked by the disturbance of World War II, have the lowest percentage in forestry work; in particular, in the Forest Service and in the Pennsylvania Department of Forests and Waters.

The number of foresters employed in private industry amounts to 25 percent of the total graduates. The balance maintained between the early graduates and the graduates of the past 10 years in this category is probably explained by the shift of the older graduates from state and federal work into private employment. This has been balanced by the increased direct employment of graduates in industry in recent years; whereas, in the early years, very few graduates began their careers in private industry.

In the private industry category, the largest number is employed in consulting and private forestry. The number of forestry consultants in Pennsylvania and in the country as a whole has increased markedly in the past 10 years, particularly in Pennsylvania where Christmas tree growing has become an active and expanding industry.

An increasing number of graduates has been employed by the pulp and paper industry, sawmill and lumber companies, and other wood-using industries. Of the graduates of the last 10 years, 18 percent is employed in these occupational fields as compared to 11 percent of the earlier graduates. This condition is no doubt due in large part to the establishment of a Department of Wood Utilization in the School of Forestry as well as to an increased appreciation of the value of professionally trained foresters by industry.

WILLIAM C. BRAMBLE
Acting director, School of Forestry, The Pennsylvania State University

Seventy-Year-Old Pine Plantation Found in Alabama

A seventy-year-old loblolly pine stand on Miss Lucy McCrary's Madison County farm is believed to be the oldest pine plantation in Alabama. According to members of the family, the trees were planted by W. W. McCrary sometime in the 1880's.

The McCrary plantation looks very much like a natural stand. Bob McCrary, a resident of Deposit, still remembers when his father planted the trees. He says no effort was made to plant the trees in rows. Wild seedlings were transplanted.

Mr. McCrary says his father originally established the plantation for use as a natural sheep shelter. The field used for this project was an eroded cornfield which had been allowed to grow up in broomsedge. For some reason the plantation never served its intended purpose. Instead, the trees were protected from fire and grazing and are today a magnificent memorial to this early tree planter.

The original planting covers an area of 6½ acres. This is surrounded by a fringe of younger trees, averaging about 45 years of age which developed from seed dropped by the older trees.

Considering only the older trees, those planted by Mr. McCrary, the plantation averages 66 trees per acre. Sawtimber volume per acre runs 22,130 board feet. The average tree is 18 inches in diameter at breast height, has three 16-foot logs, and contains 336 board feet. The largest tree in the plantation is 31 inches in diameter and contains 1,265 board feet. The trees are overmature; growth is very slow, and has been for the past 20 years.

FRANK H. MOSES
Tennessee Valley Authority, and
A. J. HYATT
Alabama Department of Conservation

FIG. 1.—Interior of 70-year-old McCrary loblolly pine plantation, Madison County, Alabama.

Radio-Isotopes—A Possible Means for Finding Defects in Logs and Trees

Foresters, timber owners, and timber and log buyers have long been searching for a way to estimate accurately the amount of internal defect contained in logs. The customary practice is to examine the tree or log for external indicators such as decayed sections, holes, malformed growths, and fruiting bodies of diseases known to infect trees. Then the examiner may hammer on the tree with an ax or hatchet to see if the bole sounds hollow. Even with a great deal of experience, he cannot be sure of his decision. The timber growing and utilization industries could benefit greatly if some scientific method were developed to locate and evaluate the extent of defects in trees and logs.

A series of studies being carried on at the Ohio State University, with cooperative-aid funds provided by the Central States Forest Experiment Station and the U. S. Forest Products Laboratory[1] is designed to find out if radio-isotopes can be used to locate internal rotten or hollow spots in a tree long before they become visible externally. Briefly, the idea is to bombard a log or tree with gamma rays (somewhat similar to X-rays) and then count the number of rays that pass through by means of an instrument called a "scintillation spectrometer." Various radio-isotopes are being studied as a source of gamma rays.

In one of the experiments, a solid log was passed in a direction parallel to its diameter between the gamma ray source and the detector and measurements were made through its cross section at ½-inch intervals. As the log moved into the gamma ray beam, the number of gamma rays counted gradually decreased until the middle part of the log was reached, and then they gradually increased as the other edge was approached (Fig. 1). When this experiment was repeated using a log with a known hollow space, the pattern became erratic because of the differences in the count rate caused by the hollow spaces in the log. Similar experiments are being continued using logs from various species of trees, in various stages of decay, with various moisture content, and of various shapes.

Not all radio-isotopes are suitable or desirable for this use. If the absorption for a given energy of gamma rays is quite rapid, then the gamma rays do not effectively penetrate through the wood. If the gamma rays are too penetrating, then the presence of a defect in the wood is not well resolved or clearly defined.

In order to determine which radio-isotopes might fulfill the requirements, the following procedure was undertaken. Twenty-four white pine boards ½"x 12"x 12" were piled one at a time between the radioactive source and the spectrometer. As each additional board was added to the pile, more gamma rays were absorbed and fewer detected. In this way it was learned that tin 113, samarium 145, and cerium 144 each emitted gamma rays that were absorbed by the white pine boards at a rate which would be useful in examining trees for defects.

Besides trying to find the most suitable gamma ray sources, the authors also have compared the use of a geiger counter versus the scintillation counter. The scintillation counter has a number of advantages. For example, preliminary findings show that differences in specific gravity among species can be compensated for by adjusting the energy source. Such adjustments are possible with a scintillation counter but not with a geiger counter.

[1]The work is being carried on under the guidance of O. Keith Hutchison, forester at the Central States Station. Both the Station and the Laboratory sincerely appreciate the facilities and cooperation provided by R. P. Sullivan and W. E. Carey of the Department of Physics at The Ohio State University.

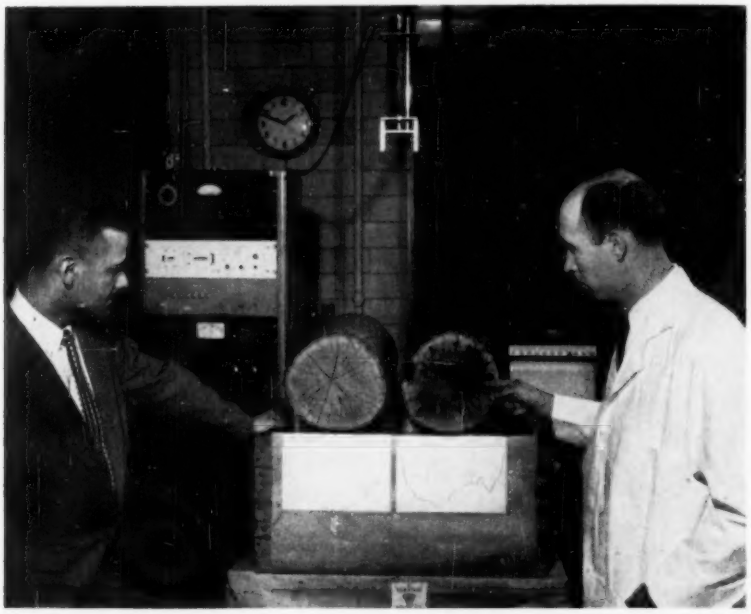

FIG. 1.—The uniform curve on the left shows the regular penetration of rays through the sound log above it; the curve for the defective log on the right is broken and erratic. These logs were studied shortly after they were cut, before drying caused the end checking visible in the photograph.

Photograph courtesy Ohio State University

Preliminary studies of the effects of moisture content and trapped water in cavities have also been made. Water under certain rare conditions may prove troublesome.

From the results of the experiments completed to date, the investigators feel confident that standing timber could be successfully analyzed using the principles described here. Assuming that a portable unit can be built, a standing tree could be analyzed in a matter of minutes. By attaching some kind of automatic recorder to the detector it should be possible to obtain a continuous and immediate measurement of gamma ray penetration through a log or tree.

This is merely a report of initial findings. A more complete and technical report is being prepared and should be available sometime this fall. Meanwhile, the authors are continuing to study the effects of solid knots, variations in moisture content, variations in specific gravity of wood, and various degrees and conditions of decay upon the attenuation of gamma rays. The researchers are already satisfied that cavities can be detected. The problem now is to develop means of evaluating the results after scanning with a scintillation spectrometer. The plan is to build a portable scintillation spectrometer for field use. It is hoped that a portable unit developed at The Oak Ridge National Laboratory can be modified and adapted to this use. By taking a portable unit to log decks and logging operations, a great deal of information could be obtained in a short time.

Future work may call for comparing this means of non-destructive testing with other means.

WAYNE B. PARRISH,
W. C. MYSER,
M. P. POOL[2]

[2]Parrish and Myser are graduate student and assistant professor, respectively, in the Dept. of Zoology, and Pool is professor of physics and astronomy at the Ohio State University, Columbus, Ohio.

Growth of Loblolly Pine Seed Trees in Relation to Crown Density

Seven years' observations in south Arkansas indicate that loblolly pine (*Pinus taeda* L.) seed trees with dense crowns make faster diameter growth than those with less foliage, but that height growth and crown expansion tend to be independent of crown density.

The trees, 55 in number, were on two areas cut back to seed trees in 1949. All competing hardwoods larger than 3½ inches in d.b.h. were deadened the same year. Most of the seed trees had about 0.05 acre of growing space apiece, but 18 had 0.08 acre. They ranged in diameter from 8 to 14 inches. Crowns were classified visually, from the ground. Three classes were represented, though not equally: dense, average, and sparse. When the study began, the means for d.b.h., height, and crown length and width did not vary from class to class (Table 1).

Statistical analysis showed that diameter growth of trees with dense crowns was greater to a highly significant degree than that of trees with sparser foliage. No other differences were significant.

Trees with dense crowns grew the equivalent of 6.4 inches in diameter per decade, while the average and sparse-crowned trees increased 5.1 and 5.0 inches respectively. All three average rates are considered excellent even under favorable rainfall conditions. However, precipitation was below normal in four out of the seven years. Shortages ranged from 3.15 to 16.10 inches of rain per year, and commonly occurred during the growing season. Under the circumstances, the diameter growth attained by the observed trees is remarkable.

CHARLES X GRANO
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TABLE 1.—LOBLOLLY PINE SEED-TREE DEVELOPMENT BY CROWN DENSITY CLASS, 1950-56 INCLUSIVE

Crown density class	Diameter		Height		Crown length		Crown width	
	Original size	Annual increase	Original size	Annual increase	Original size	Annual increase	Original size	Annual increase
	Inches		*Feet*					
Dense	12.5	0.64	69	0.9	35	0.7	22	0.4
Average	11.7	.51	67	1.0	31	.6	19	.4
Sparse	11.8	.50	69	.9	33	.6	18	.4

Reviews

The Forest Is the Future

By Jonathan Daniels. 66 pp. Illus. International Paper Co., New York. 1957. (No price.)

Jonathan Daniels is the nationally known editor of *The News and Observer* of Raleigh, N. C. and the author of several distinguished books dealing with the American scene. Invited by the International Paper Company to report on the pulp and paper industry in the South, he accepted, and this booklet is the happy result.

In summary, he examines the economic and social developments that have had such a tremendous impact on the South by reason of the growth of the pulp and paper industry and the consequent expansion of forestry. In passing, he pays gracious tribute to the late Charles H. Herty, the ardent scientist whose enthusiasm had so much influence on the birth of the industry.

Although International Paper Company is prominently and frequently cited, the booklet is by no means a blatant piece of publicity. Indeed, most of the other companies in the South are mentioned, too. Their contributions to the industry's expansion are discussed so interestingly that the reader cannot fail to comprehend the role that this industry has played over the past three decades against the backdrop of the great depression, the significant adjustments in agriculture, and a renascent Southland.

This great industry has brought new jobs, new schools, new homes, and, in short, new life to the South. Moreover, it has accelerated the practice of forestry as no other single factor has done. International deserves commendation for making available to the public this fascinating account of what, why, and how it all happened.

Mr. Daniels makes some exceedingly kind remarks about foresters. Not only do the industrial foresters come in for commendation, but the state and federal forestry agencies as well are given appropriate credit for their share in the expansion of the industry. This is as it should be, but a superficial reporter, which Mr. Daniels is not, could have overlooked, by accident or design, the not inconsiderable contributions of the public foresters. History may some day record that one of the happiest events in the annals of American business occurred when the forester and the paper maker teamed up to grow and utilize the "green gold" of Dixie.

Printed by offset lithography on quality paper and attractively illustrated, this handsome publication is an interesting example of the typographer's art.

HENRY CLEPPER

Tree Care

By John M. Haller. 224 pp. Illus. Macmillan Co., New York. 1957. $5.95.

Written by an arborist for the homeowner and interested layman, this book covers the many facets of the science of arboriculture in a thorough nontechnical manner. Frequent explanation of terminology and the practices in arboriculture gives the reader a speaking acquaintance with the heretofore little explained science. Foresters will find many of their questions concerning this subject adequately explained. In a field of endeavor that regrettably attracted a disproportionate share of itinerant, poorly trained, and shady operators, information of the caliber presented in this book is a major contribution to the education of an interested but poorly informed public.

The six major phases of tree care —planting, pruning, cavity repairing, cabling and bracing, fertilizing, and spraying—are treated in separate chapters. In additional chapters, tree structure and physiology, insects, diseases, and environmental damage are discussed. Separate chapters are devoted to answering common questions concerning tree care and sources of tools, equipment, and books.

The opening chapter provides an explanation of the structure and functioning of each part of the tree in an orderly manner. The translation of scientific data into popular proses requires both the technical and literary background which Mr. Haller possesses and applies to this book.

The major phases of tree care are well treated and adequately covered. A section entitled "Advice to Home Owners" points up particular considerations to be made before making major expenditures.

For cavity repair, the author carries the explanation of the techniques involved to the limit and might well have resorted to more photographs to describe this phase.

In both the chapter on fertilizing and on spraying, the introductory remarks are particularly informative to the homeowner. As each of these operations may require a large expenditure of money with no immediate apparent results, the subject deserves this full explanation.

Photographs are used to show contrasting views of good and poor workmanship, proper and improper appliances, and techniques of the trade. Typical tree forms, flowers, and features of structure are included in the collection of excellent photographs. However, the effectiveness of the photographs would have been greater had the photo

pages been located adjoining the text being illustrated rather than in a mixed assortment.

By treating insects, diseases, and environmental damage in successive chapters the author serves notice that the care of trees is not confined to the control of a single condition and may well involve a complex and involved situation for both the tree and the arborist.

The technique of using glue at a dilution of 1 ounce to 100 gallons of water appears to be incorrect; and the use of this sticker in a stronger solution to "actually stick down some of the smaller insects" is not an effective method in view of the wide selection of miticides now available to arborists and homeowners.

The mention of a list of all-purpose trees will undoubtedly invoke heated discussions among arborists despite the subsequent modifications of this rather general list of trees. There is now being grown a wider selection of trees than those listed and the reader would be wise to consult other works before settling on a species to plant. Consulting a reputable local arborist would be an ideal method to use in the selection.

C. A. YOUNG, JR.
City forester,
Baltimore, Md.

❦ ❦ ❦

The Climate Near the Ground

Second printing, revised, of the second German edition of *Das Klima der bodennahen Luftschicht* by Prof. Dr. Rudolf Geiger, translated by Milroy N. Stewart and others. 494 pp. Illus. Bibliography. Harvard University Press, Cambridge. 1957. $6.

European microclimatology in 1950 receives detailed and well-organized coverage. Findings from hundreds of studies, many by the author, are presented in a detailed breakdown permitting broad subject coverage within a single text. Microclimatic factors that affect plant and forest stands are given greatest attention.

The German second edition (1941) was translated following World War II. About the time translation was completed, Dr. Geiger was located and it was learned that a German third edition was ready for publication. Informed of the translation, Dr. Geiger consented to supply additional material that would make the translation the equivalent of the German third edition (1950). In this second printing of the revised translation, Dr. Geiger has made minor corrections and has added an extensive up-to-date bibliography for each chapter including some 500 recent books and papers, many of which are in English. The text uses material from a similar number of earlier works, which are also listed for each chapter.

The author has long been one of the foremost researchers in the field of microclimatology. He has been closely associated with foresters as director of the Meteorological Institute of the Forestry College at the University of Munich.

Survival of living things depends greatly on the climatic extremes to which they are subjected. No one is more aware of this than the forester responsible for reforesting cutover lands. Particularly enlightening to him will be the discussion of temperature in the soil, at the surface, and in the air as summarized by the author from many careful studies. Likewise, the forester who is concerned with phenological variations, or who may attempt to distinguish between genetic trait differences and effects of variation in microclimate, will benefit from the many chapters concerned with effects of topography and cover on microclimate.

Fire control personnel will be interested in the discussion of slope winds and in the chapter on validity of individual observation stations. Watershed managers will be interested in the microclimatic aspects of snowcover and ponds, and in studies of evaporation, transpiration, and variation in rainfall. Forest managers will be interested in the discussion of microclimatic changes resulting from variations in cutting practice, stand composition, and size of opening. Actually, the wealth of information on the many phases of microclimatology covered in Geiger's book is of interest to all foresters.

This book apparently is still the only text in its field. Although it has been written almost entirely from European studies, the principles have world-wide application. It is unfortunate, however, that most American readers will be unfamiliar with the localities at which the studies were conducted. The reference to European botanical species and the use of metric units—Celsius (formerly Centigrade) degrees, meters per second, and meters of elevation—also are obstacles to easy comprehension.

Treatment of the subject is mostly empirical and exploratory, though theory is not neglected where needed. The heat budget and heat exchange in particular are well covered. The text is well supplied with illustrative diagrams, charts, pictures, and tables. Translation was by technical experts who have done a remarkable job of producing an easy-to-read style.

A review of the first printing of this book was made by David M. Smith and was published in the April 1951 JOURNAL OF FORESTRY, p. 294.

OWEN P. CRAMER
Pacific Northwest Forest and Range Experiment Station

❦ ❦ ❦

John & William Bartram's America

By Helen Gere Cruickshank. 418 pp. Illus. Devin-Adair Co., New York. 1957. $5.

Mrs. Cruickshank has carefully reviewed the journals of John and William Bartram. She has chosen from these those parts which seem most likely to give a sharp picture of the wilderness in colonial America.

Most of the work is made up of the writings of William Bartram, who was much more fluent than

his pioneering father, John. It is obvious from his letters that John, the father, was the field man and the collector. He was not as painstaking in his writing as his son.

The foreword by B. Bartram Cadbury, the introduction by Mrs. Cruickshank, and the biographical sketch from the Pioneers of Science in America provide an excellent approach to the selected material from the naturalists' journals.

William Bartram's drawings attest to the great skill which he had as an observer of nature and to his no mean ability as an illustrator.

Francis Lee Jacques' black and white illustrations scattered through the text are very well done and make an attractive accent to the journals.

Some minor errors exist in the work. One of these, in a map by Francis Lee Jacques. Mr. Jacques' map of John Bartram's trail from Philadelphia to Oswego shows Shamokin at its present location, about 18 miles southeast of the junction of the north and west branch of the Susquehanna River. The Shamokin to which John Bartram refers in his journal was at the present location of Sunbury. This same error is introduced in the journal by the statement in brackets by the editor. The Indian town Shamokin, or the "Place of the Horns," was at the junction of the two branches of the Susquehanna. Errors such as this were minor.

Most of the territory described in the journals is in Florida, Georgia, and the Carolinas. Some localities are quite vividly pictured. It should be possible to make detailed comparisions of the vegetation now present with that in the colonial wilderness. Since most of their travels were in forested areas in the Southeast where interest in forestry is high, the contrast of the present and past should be especially interesting to the many foresters practicing in that part of the country.

The journals of both men detail some aspects of the mode of life of several of the Indian tribes. Their attitude toward the Indians was relatively free from bias. They appear to have accepted the situations as they were, and described them as they found them. The attitude of the settlers to the Indians, and the Indians to the colonials is of historic interest.

The most striking aspect of the journals is the grasp of natural history which these two men acquired. They did without textbooks or guides to systematic zoology or botany, and appear to have made considerable progress in systematizing their knowledge of natural history. They had to be self-taught, and they had to develop their own taxonomic system in the process.

Mrs. Cruickshank has performed a very valuable service in bringing these two scientists to the attention of the modern American.

Some of the evidence of the travels can still be seen at John Bartram's home which is now preserved as part of the city park system in Philadelphia. The old stone house he built and many of the woody plants he established in his garden are there for the visitor to observe and enjoy.

RICHARD M. MAY
Willimantic, Conn.

California Coast Redwood

Compiled by Emanuel Fritz. 267 pp. Illus. Foundation for American Resource Management, San Francisco. $7.50.

For the use of authors and students interested in studying or reviewing the extensive literature pertaining to redwood, the Foundation for American Resource Management has just published in book form an annotated bibliography of more than 2,000 numbers compiled by Emanuel Fritz, professor of forestry emeritus, University of California, consulting forester for the California Redwood Association, and for many years a specialist in redwood.

The book, *California Coast Redwood*, printed by the Recorder Press of San Francisco, includes an explanatory introduction, a classified table of contents, the citations and annotations, authors' index, and a 16-page cross-referenced subject index.

Each citation is numbered consecutively across the several classifications which include history of discovery and operations, economics, botany of the tree, forest description, lumbering, products, aesthetics, recreation, the ornamental use of redwood, and its planting in foreign countries.

The Foundation for American Resource Management, at 582 Monadnock Building, San Francisco, is a non-profit corporation, dedicated to the management of natural renewable resources to gain their complete use without impairment of their productivity.

Publications of Interest

The first official motion picture made in 20 years about the work of the U. S. Forest Products Laboratory, Madison, Wis., has been released for public showing, Director J. A. Hall has announced.

The 16-millimeter full-color film, titled "A Piece of Wood," was produced by the Department of Agriculture for the Forest Service. The film shows changes brought about in the pulp and paper industry by new processes developed at the Laboratory, and the expansion of the laminating industry as a result of research in the gluing and laminating of wood.

The 13½ minute film, complete with sound track, is available on free loan to groups. Prints can be obtained by writing any regional office of the Forest Service.

* * *

A summary of the proceedings of the Fifth Biennial Wilderness Conference, held March 15 and 16 in San Francisco, Calif., appears in the June issue of the *Sierra Club Bulletin*. "Wildlands in Our Civilization," the theme of the conference, is the one used also for the *Bulletin*, and its contents are drawn from the papers presented there. Address inquiries about copies to the Sierra Club, 2061 Center Street, Berkeley 4, Calif.

Current Literature

Compiled by MARTHA MEELIG, *Librarian, State University College of Forestry at Syracuse University*
Range Management Section Complied by Division of Bibliography, Library, U. S. Department of Agriculture

General

The Adventurers, a novel. By Ernest Haycox. 332 pp. Little, Brown, Boston. $3.95.

The Community of Living Things. By Stephen Collins. 5 vols. (Vol. 4—In Forest and Woodland.) Illus. Creative Educational Society, Inc., Mankato, Minn. in coop. with National Audubon Society. 1956. $7 per volume.

Forestry in the South. By M. D. Mobley and R. N. Hoskins. 440 pp. Turner E. Smith & Co., Atlanta, Ga. 1956.

Higher Education in Forestry and Other Natural Resources in Michigan; a report by the Natural Resources Study Group. . . Michigan Council of State College Presidents. 49 pp. J. W. Edwards, Publ., Ann Arbor. 1956. $2.

Indoor Care of Christmas Trees and Greens. By A. N. Lentz, W. C. Krueger and Gena Thames. 4 pp. Rutgers-State Univ. College of Agriculture. Ext. Serv., New Brunswick, N. J. 1956. Leaflet No. 173.

My First Wildlife Library; True to Life Stories. By R. W. Eschmeyer. 10 books. Illus. American Forestry Assn., Washington 6, D. C. $1 per vol. packed in bookcase; 50 cents per vol. paper-backed.

Chemical Debarking

Chemical Debarking of Southern Trees. By W. S. Thompson and K. C. Birdsall. 27 pp. Illus. Mississippi State College Agric. Expt. Sta., State College. 1957. Tech. Bul. No. 42.

Conservation

Using Resources Wisely. 48 pp. Illus. New York State Education Dept. Bur. of Elementary Curriculum Development and Bur. of Secondary Curriculum Development, Albany. 1956.

Logging and Milling

Cost of Logging Virgin Ponderosa Pine in Central Idaho. By A. K. Wilson and G. H. Greenway. 15 pp. Illus. Intermountain Forest and Range Expt. Sta., Ogden, Utah. 1957. Research Paper No. 51. Mimeog.

High-Temperature Kiln-Drying of Eastern Canadian Softwoods; Drying Guide and Tentative Schedules. By J. L. Ladell. 18 pp. Illus. Canada Forestry Branch, Ottawa. 1957. Tech. Note No. 2.

A Small Sawmill Enterprise. 96 pp. Illus. International Cooperation Admin., Washington 25, D. C. 1957.

Pathology

The Influence of Moisture and Other Factors on the Activity of Heartwood Fungi in Subalpine . . . Spruce. By D. E. Etheridge. 114 pp. Illus. Canada Dept. Agric. Science Serv., Forest Biology Div. 1957. Interim Rept. Forest Biology Lab., Calgary, Alta. Mimeog.

Pole Blight of Western White Pine. By C. D. Leaphart, O. L. Copeland, Jr. and D. P. Graham. 4 pp. Illus. U. S. Dept. Agric., Washington 25, D. C. 1957. Forest Pest Leaflet No. 16. 5 cents (Govt. Print. Off.).

Red Heart Stain of Lodgepole Pine Logs in the Northern Interior of British Columbia. By H. W. Eades and J. W. Roff. 14 pp. Forest Products Labs. of Canada, Vancouver. 1957.

Silviculture

Forest Nursery Practice in the Lake States. By J. H. Stoeckeler and G. W. Jones. 124 pp. Illus. U. S. Forest Service, Washington 25, D. C. 1957. USDA Agric. Handbook No. 110. $2.

Propagation of Woody Plants by Cuttings. By W. L. Doran. 99 pp. Univ. of Massachusetts College of Agric., Amherst. 1957. Ext. Sta. Bul. No. 491.

Reforestation Estimates for the Tennessee Valley. 8 pp. Illus. TVA, Norris. 1957.

Silvical Characteristics of Black Spruce. By M. L. Heinselman. 30 pp. Lake States Forest Expt. Sta., St. Paul 1. 1957. Sta. Paper No. 45. Mimeog.

Silvical Characteristics of California Red Fir and Shasta Red Fir. By W. E. Hallin. 8 pp. California Forest and Range Expt. Sta., Berkeley. 1957. Tech. Paper No. 16. Mimeog.

Silvical Characteristics of Red Pine. By P. O. Rudolf. 32 pp. Illus. Lake States Forest Expt. Sta., St. Paul, 1957. Sta. Paper No. 44. Mimeog.

Silvical Characteristics of Rock Elm. By H. F. Scholz. 16 pp. Illus. Lake States Forest Expt. Sta., St. Paul. 1957. Sta. Paper No. 47. Mimeog.

Soils

Forest Fertilization; A Bibliography, with Abstracts, On the Use of Fertilizers and Soil Amendments in Forestry. Comp. by D. P. White and A. L. Leaf. 305 pp. State Univ. College of Forestry, Syracuse 10, N. Y. 1957. Tech. Publ. No. 81. World Forestry Ser. Bul. No. 2.

Wildlife Management

Management of a Poletimber Forest for Wildlife Food and Cover. By W. M. Sharp. 26 pp. Illus. Pennsylvania State Univ. Agric. Expt. Sta. University Park, Pa. 1957. Bul. No. 620.

Wood Preservation

Fire-Retardant Treatments for Wood. 7 pp. Illus. U. S. Forest Products Lab., Madison 5, Wis. 1957. Rept. No. 2081. Mimeog.

Full-Cell Treatment of Kiln-Dried Coast-Type Douglas Fir Piling with Creosote and Creosote-Coal Tar. By D. J. Miller and R. D. Graham. 7 pp. Illus. Oregon Forest Products Lab., Corvallis. 1957. Rept. No. P-2. Mimeog.

Full-Cell Treatment of Kiln-Dried Douglas Fir Crossties with Creosote-Coal Tar. By R. D. Graham and D. J. Hiller. 5 pp. Illus. Oregon Forest Prod. Lab., Corvallis. 1957. Rept. No. P-4.

Wood Technology and Utilization

How to Install and Finish Hardwood Lumber Paneling. By C. I. Miller and R. C. Brundage. 11 pp. Illus. Purdue Univ. Agric. Ext. Serv., Lafayette, Ind. 1956. Ext. Cir. No. 424.

Interior Wood Paneling and Its Finishing. By J. B. Sharp. 7 pp. Univ. of Tennessee Agric. Ext. Serv., Knoxville. 1957. Spec. Cir. No. 507. Mimeog.

Nail-Glued Roof Trusses from Low-Grade Hardwood Lumber. By D. H. Percival. 25 pp. Purdue Univ. Agric. Expt. Sta., Lafayette, Ind. 1957. Sta. Bul. No. 649. Mimeog.

Production of Wallboard from Wood Waste. By F. Bender and F. W. King. 43 pp. Illus. Forest Products Laboratories of Canada, Ottawa. 1957. Bul. No. 120.

Quality and Performance of Sliced Shook from Small Ponderosa Pine Logs. By W. F. E. Immelman. 40 pp. Illus. U. S. Forest Products Laboratory, Madison, Wis. 1957. Rept. No. 2076. Mimeog.

The Sorption of Water Vapour by Wood. By K. K. Kelsey. pp. 43-54. Illus. Commonwealth Sci. & Indus. Research Org., Australia. Div. of Forest Products. Melbourne. 1957. Reprint No. 308. Aust. Jour. of Appl. Sci. Vol. 8, No. 1.

Studies on Izod Values of Some Indian Timbers. By A. C. Sekhar and D. D. S. Negi. 20 pp. Illus. Manager of Publications, Delhi. 1957. Indian Forest Bul. No. 201. 1/14/- or 2 sh. 9d.

Society Affairs

Officers and Council 1956-1957

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Sacramento 14, Calif.

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2026 St. Charles Avenue
New Orleans 13, La.

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Florida Forest Service
Tallahassee, Fla.

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Washington 6, D. C.

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State University of New York
Syracuse 10, N. Y.

J. HERBERT STONE
U. S. Forest Service
729 N.E. Oregon St.
Portland 8, Ore.

HENRY J. VAUX
School of Forestry
University of California
Berkeley 4, Calif.

Biennial Election

Ballots for the regular biennial election were sent to over 9,700 voting members of the Society in mid-October. These ballots will be counted on December 2 and the newly elected officers and Council members will take office January 1, 1958 for term 1958-1959.

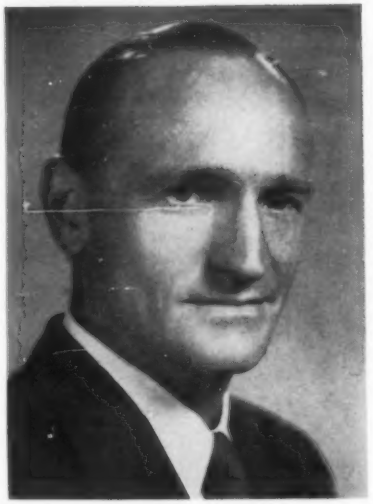
Photographs of the nominees are published in this issue. Lists of nominees have appeared in Society Affairs monthly as they were received in the Society office.

Nominees For President

GEORGE A. GARRATT. Dean, School of Forestry, Yale University, New Haven, Conn.

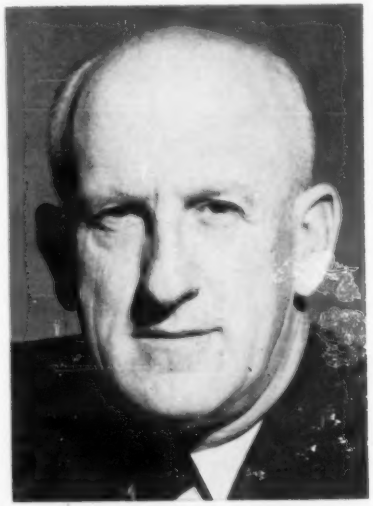
HENRY J. MALSBERGER. General manager and forester, Southern Pulpwood Conservation Association, Atlanta, Ga.

B. E. ALLEN. Assistant manager, Woodlands Division, Union Bag-Camp Paper Corporation, Savannah, Ga. Southeastern Section.



PHILIP A. BRIEGLEB. Director, Southern Forest Experiment Station, New Orleans, La. Gulf States Section.

DONALD E. CLARK. Regional forester, Rocky Mountain Region, U. S. Forest Service, Denver, Colo. Central Rocky Mountain Section.

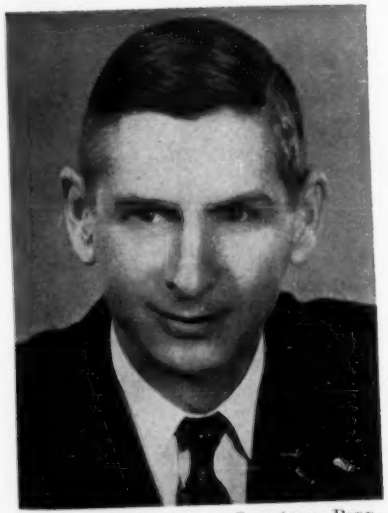


CHARLES A. CONNAUGHTON. Regional forester, California Region, U. S. Forest Service, San Francisco, Calif. Northern California Section.

KENNETH P. DAVIS. Chairman, Department of Forestry, professor of forest management, School of Natural Resources, University of Michigan, Ann Arbor, Mich. Wisconsin-Michigan Section.

MURLYN B. DICKERMAN. Director, Lake States Forest Experiment Station, St. Paul, Minn. Upper Mississippi Valley Section.

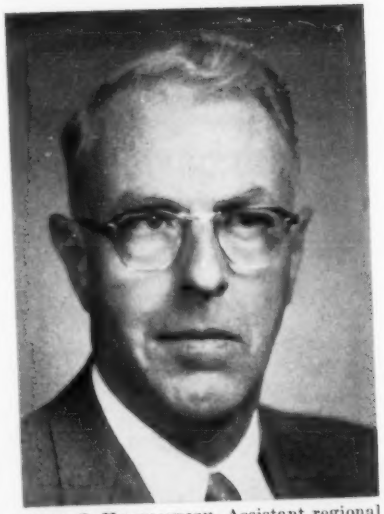
GLEN R. DURRELL. Professor of forestry and head of the Department of Forestry, Oklahoma A & M College, Stillwater, Okla. Ozark Section.



MAURICE K. GODDARD. Secretary, Pennsylvania Department of Forests and Waters, Harrisburg, Pa.; on leave as director of the School of Forestry, The Pennsylvania State University. Allegheny Section.

RUDOLPH H. GRABOW. Businessman, Bedford, Ind. Central States Section.

WILLIAM D. HAGENSTEIN. Managing director, Industrial Forestry Association, Portland, Ore. Columbia River Section.



DAHL J. KIRKPATRICK. Assistant regional forester, Southwestern Region, U. S. Forest Service, Albuquerque, N. Mex. Southwestern Section.

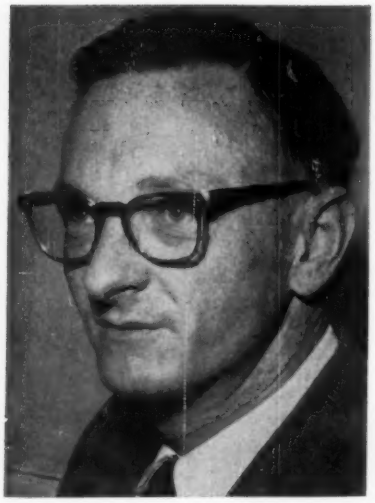
PETER T. LANNAN, JR. Administration of research, West Virginia Pulp and Paper Company, Georgetown, S. C. Appalachian Section.

LAWRENCE S. NEWCOMB. Forest supervisor, Mississippi National Forests, Jackson, Miss. Gulf States Section.

ALBERT D. NUTTING. Forest commissioner, Maine Forest Service, Augusta, Me. New England Section.

RUSSELL STADELMAN. Chief forester, Forestry Division, Nickey Brothers, Inc., Memphis, Tenn. Kentucky-Tennessee Section.

HERBERT J. STONE. Regional forester, Pacific Northwest Region, U. S. Forest Service, Portland, Ore. Columbia River Section.



HENRY J. VAUX. Dean, School of Forestry, University of California, Berkeley, Calif. Northern California Section.

ERNEST WOHLETZ. Dean, College of Forestry, University of Idaho, Moscow, Idaho. Inland Empire Section.

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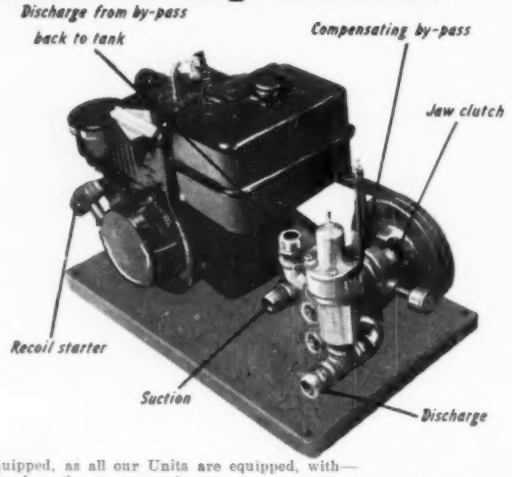

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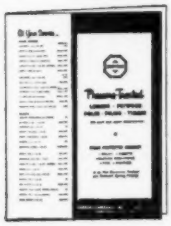

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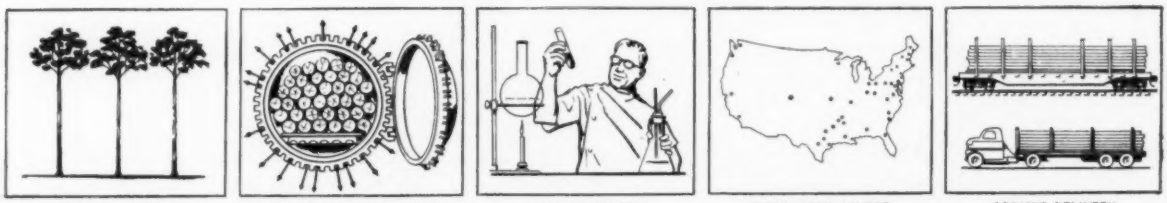

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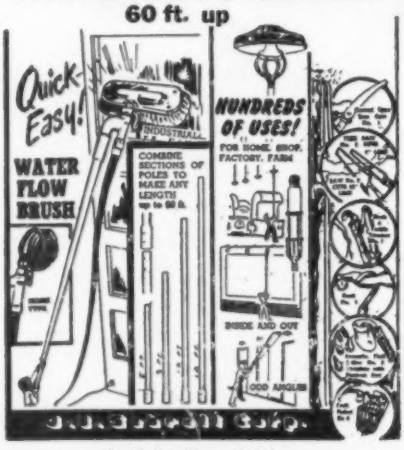

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The President's Column

DEWITT NELSON

I have been reviewing some notes taken at a recent national meeting of foresters and laymen.

Here are a few quotes which will not be exact for they were jotted down as the conference proceeded:

"Research must go forward to determine that which we must do tomorrow for it will not then be possible to do as we are doing today."

"The man who invented the term 'weed-species' did forestry a grave injustice."

"In many regions we have adequate volume but a shortage of high quality material."

"We must and are adapting our uses to fit the material available."

"There are no worthless species, as technologies develop and economic conditions change, we will find a use for every species and for a higher and higher percentage of every species."

"Utilization by more complete integration is a growing necessity."

"Markets govern silviculture."

"We must manage our lands to produce the highest quality of wood with maximum yields."

"Prompt restocking is essential."

"We should learn to use species that grow rapidly rather than try to develop rapid growth in other species."

"We need more professionally trained men to keep pace with demands."

Quoted from Aldo Leopold—"Conservation is a state of harmony between nature and man. The battle of conservation will be won or lost in the minds of men." "We must engender the love and respect for the land to win this battle."

These random quotations embody fundamentals, philosophies, and ideals. They set forth problems and suggest solutions. They show concern but express confidence in the future and in the profession of forestry. They portray the three objectives of the Society which were set forth fifty years ago.

Harmony between man and nature first calls for knowledge, understanding, and harmony between men. In this day of competition for land and resources this is a real challenge to America: foresters must play a leading role in its solution.

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HPZF	15	200
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Increase in Cost of Journal Binder

Increased manufacturing costs necessitate an increase in price to $3 of binders for the JOURNAL OF FORESTRY. This price will be effective as of December 1, 1957.

Binders hold 12 issues of the JOURNAL OF FORESTRY. They are of brown imitation leather, stiff board, square corners, lined. The title JOURNAL OF FORESTRY is stamped on front cover and backbone in gold foil.

The Constitution Amended

As of August 31, 1957 the voting membership of the Society, by considerably more than the necessary two-thirds majority, approve five amendments to the Constitution. The amended sections now read as follows:

Fellows Defined

Article III, Section 7. Fellows shall be foresters recognized generally throughout the profession as persons who have rendered outstanding service to forestry and to the Society. They shall be elected from the Members.

Endorsement of Applications

Article IV, Section 2 (first paragraph). Applications for the following two grades of membership may be endorsed by one voting member: Student Membership and Junior Membership when applicants are graduates of approved curricula in accredited schools. Applications for Affiliate Membership who qualify on the basis of education may be endorsed by three voting members.

Nomination of Fellows

Article IV, Section 3. Nominations to the grade of Fellow shall be by the written endorsement of twenty-five Members and/or Fellows.

Election of Fellows

Article IV, Section 4. Election to the grade of Fellow shall be concurrent with the regular biennial Council election, and shall be by letter ballot of the Fellows, the members of the Council, the chairmen of the Sections, and the chairmen of the subject Divisions. The total number of votes necessary to elect shall be determined by the Council as provided in the Bylaws.

Dues of Associate and Affiliate Members

Article V, Section 2. Effective January 1, 1958 annual membership dues shall be as follows:

For Fellows, $15.

For Members, $12 for their first six years in this grade; $15 thereafter.

For Junior Members and Affiliate Members, $6 for their first three years in this grade; $9 for their second three years in this grade; $12 thereafter. Dues of Junior Members advanced from the Affiliate grade shall be based on the date of their election to Affiliate Membership.

For Associate Members, $9.

For Student Members, $3.

Honorary and Corresponding Members shall not be charged dues.

Amendments to the Bylaws

The following amendments to the Bylaws received the unanimous approval of the Council, and are now in effect.

Bylaw 9. Requirements for Fellow. Meritorious contributions to forestry, the basic requirement, shall include contributions to the application of forestry in any of its branches, to education, to research, to the advancement of the profession, and service to the Society.

Bylaw 10. Fellow Nominations. With each petition nominating a Member for advancement to Fellow must be submitted an adequate biographical sketch of the nominee, including a record of his education and training, professional responsibilities and achievements, previous special awards and honors, services to the Society, and other significant contributions and services. A factual biographical summary of each nominee, containing not more than 300 words, shall accompany the ballot.

New Bylaw. Election of Fellows. The total number of votes necessary to elect a Member nominated to the grade of Fellow shall be not less than 50 percent of the total number of votes cast.

Coming Events

Northeastern Wood Utilization Conference

Northeastern Wood Utilization Council has announced a conference on "Charcoal Production and Uses" to be held in the Connecticut Agricultural Experiment Station, New Haven, Conn., November 20.

Kentucky-Tennessee Section

The Kentucky-Tennessee Section has scheduled a meeting for December 6 and 7 in Nashville, Tenn.

Northern California Section

The annual winter meeting of the Northern California Section will be held in the Merchandise Mart, San Francisco, on December 7.

Western Forestry and Conservation Assn.

The Western Forestry and Conservation Association will hold its 48th annual conference December 11-13 in Seattle, Wash. Theme: "The business of tree farming."

Northeast Wildlife Conference

The Northeast Wildlife Conference will be held January 4-7, 1958, in Montreal, Canada. Information, reservations: Gustave Prevost, G 3, Universite de Montreal, Montreal 3, Que.

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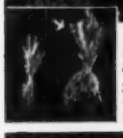

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Forest Practices Developments in the United States, 1940-1955

Report of the Committee of Forest Practices, Division of Silviculture, Society of American Foresters, Kenneth P. Davis, *Chairman.*

The report is in three parts: (1) highlights of major developments affecting forest practices during 1940-1955, (2) digest and summary of present state legislation on cutting practices, and (3) annotated bibliography with a key to 1940-1955 literature.

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John B. Woods (1890-1957)

John B. Woods, 66, of Salem, Ore., died suddenly on September 3.

Born September 16, 1890 at St. Johnsbury, Vt., he attended Brown University, then went to old Biltmore Forest School, graduating in 1913 with the B. F. degree. He was granted the F. E. degree in 1913.

During 1914-1917 he engaged in logging and sawmill operations in Arkansas. Commissioned a first lieutenant in the 10th Engineers (Forestry) in 1917, he served in France and rose to captain.

Appointed a forest valuation engineer in the southern pine region for the U. S. Treasury Department, he resigned in 1923 to become forester for the Long Bell Lumber Company. During 1934-1935 he directed forest practice rules under the Lumber Code Authority.

Appointed forester in 1935 for the National Lumber Manufacturers Association in Washington, D. C., he resigned four years later to become secretary-manager of the Oregon Forest Fire Association. During 1943-1946, he was director of the Forest Resource Appraisal of the American Forestry Association.

For the past decade he operated a forest tree seed business in Salem, Ore. His son, John B. Woods, Jr., also a professional forester, has been associated with him in the business during recent years. Mr. Woods was the author of *Your Oregon* and of numerous articles and other publications on forestry.

Page S. Bunker (1875-1957)

Col. Page S. Bunker, 82, former state forester of Alabama, died in Montgomery, Ala., on September 9.

He was born in Minomonie, Wis., and was educated at the University of Wisconsin, University of Montana (B. A. 1904), and Texas A & M College.

Entering federal forestry employment in 1904 as a ranger in the U. S. Department of the Interior, he transferred to the U. S. Forest Service (1906-1914) as supervisor. Following state and private forestry employment in Massachusetts, he re-entered federal service as a land appraiser for the Interstate Commerce Commission. Becoming assistant state forester of Texas in 1921, he subsequently was appointed state forester of Alabama, serving from 1924 to 1939. He joined the Alabama State Planning Board in 1947 as principal technician.

An Army veteran of the Spanish-American War and of World War I and II, he retired as a full colonel (reserve). He was a former Member of the Society of American Foresters.

Ohio Chapter Issues Forest Management Manual

The Ohio Chapter of the Central States Section has recently compiled a useful forest management publication. Prepared by the Chapter's Cutting Practices Committee, under the chairmanship of Willard H. Carmean, it is a 36-page mimeographed document titled "Recommended Management Practices for Forest Land in Southern Ohio."

In this southern Ohio area, 39 percent of the land is forested. Comprising one-third of the area of the state, it contains three-fifths of Ohio's wooded acreage. The bulletin prescribes general practices for this diverse and complex region.

A limited number of copies are available for distribution to Society members outside the Section. They may be obtained on written application to Mr. Willard H. Carmean, Athens Forest Research Center, P. O. Box 475, Athens, Ohio.

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E. R. Martell (1901-1957)

Dr. Eldred R. Martell, 56, head of the Department of Forestry at Purdue University, was found dead in his automobile near Rochester, Minn. on September 28. In ill health, he had been registered at the Mayo Clinic. Death occurred apparently by his own hand.

Dr. Martell had been affiliated with Purdue since 1940, when he became director of the School of Forestry. Previously he taught at the University of Idaho and at Penn State University.

Born September 4, 1901 in Romeo, Mich., he was educated at the University of Michigan. He received his B.S.F. in 1925, his M.S.F. in 1926, and his Ph.D. in 1932.

Program for Meeting of American Association for the Advancement of Science

Section O (Agriculture) Louis P. Reitz, *Chairman*

Indianapolis, Ind., December 28, 29, 30, 1957

Theme: *Biological and Chemical Control of Plant and Animal Pests*

SYMPOSIUM I. Recent Advances in Chemical Control Measures, Bamboo Room, Washington Hotel, Dec. 28, 9:00 a.m.—R. L. Lovvorn, North Carolina State College, presiding.

9:00— 1. Insecticides—John C. Keller, ARS, U. S. Department of Agriculture, Beltsville, Md.

9:30— 2. Herbicides—R. H. Beatty, American Chemical Paint Company, Ambler, Pa.

10:00— 3. Fungicides and bactericides for control of plant diseases—George L. McNew, Boyce Thompson Institute for Plant Research, Inc., Yonkers, N. Y.

10:30— 4. Chemical control of internal parasites of domestic animals—F. O. Gossett, The Lilly Research Laboratories, Indianapolis, Ind.

11:00— 5. Systemic antibiotics and chemicals, their movement and mode of action—John E. Casida, The University of Wisconsin, Madison, Wis.

11:30— Questions and discussion.

SYMPOSIUM II. Recent Advances in Biological Control Measures, Bamboo Room, Washington Hotel, Dec. 28, 2:00 p.m.—H. Rex Thomas, U. S. Department of Agriculture, presiding.

2:00— 6. Parasites and predators for pest control—Charles A. Fleschner, University of California, Riverside, Calif.

2:25— 7. Controls for pests of forest species—

2:50— 8. Pathogens for the control of pests—John D. Briggs, State Natural History Survey Division, Urbana, Ill.

3:15— 9. Antagonism as a control principle—Wm. C. Snyder, University of California, Berkeley, Calif.

3:45—10. Irradiation for pest control—E. F. Knipling, ARS, U. S. Department of Agriculture, Beltsville, Md.

4:15— Questions and discussion.

SYMPOSIUM III. Inherent Resistance to Pests, Bamboo Room, Washington Hotel, Dec. 29, 2:00 p.m.—H. B. Sprague, Pennsylvania State University, presiding.

2:00—11. Disease resistance in animals—Nelson F. Waters, ARS, U. S. Department of Agriculture, East Lansing, Mich.

2:30—12. Breeding plants for resistance to insect pests—Reginald H. Painter, Kansas State College, Manhattan, Kans.

3:00—13. Breeding vegetable and fruit crops for resistance to diseases—J. R. Shay, Purdue University, Lafayette, Ind.

3:30—14. Breeding field crops for resistance to diseases—Ernest H. Stanford, University of California, Davis, Calif.

4:00—15. Nutrition of the host and reaction to pests—J. G. Rodriguez, University of Kentucky, Lexington, Ky.

4:30— Questions and discussion.

SYMPOSIUM IV. Problems Related to and Consequences of Biological and Chemical Control Measures, Bamboo Room, Washington Hotel, Dec. 30, 9:00 a.m.—T. C. Byerly, ARS, U. S. Department of Agriculture, presiding.

9:00—16. Biological balance as affected by disease and insect control practices—A. D. Pickett, Science Service Laboratory, Canadian Department of Agriculture, Kentville, Nova Scotia.

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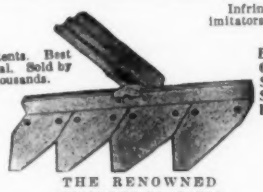
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SCHOOL BOX SCORE
1957 MEMBERSHIP

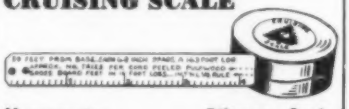
School	Student applications received: Nov. 1957	Total 1956	Total 1957
Alabama Polytechnic Institute	0	6	19
University of California	0	53	10
Colorado State University	0	28	16
Duke University	0	7	4
University of Florida	1	25	6
University of Georgia	0	30	65
University of Idaho	0	21	15
Iowa State College	0	31	18
Louisiana Polytechnic Institute	10	27	11
Louisiana State University	0	22	19
University of Maine	0	13	18
University of Massachusetts	2	20	4
Michigan State University	0	50	9
University of Michigan	0	24	9
University of Minnesota	0	26	27
University of Missouri	0	2	36
Montana State University	0	17	45
State University of New York	0	38	24
North Carolina State College	0	24	1
Oregon State College	0	44	29
Pennsylvania State University	1	35	30
Purdue University	0	36	2
Utah State University	0	28	5
University of Washington	0	21	16
West Virginia University	0	5	19
Yale University	0	13	5
Totals	14	646	462

SECTION BOX SCORE
1957 MEMBERSHIP

Section	Applications received[1]: Nov. 1957	Total 1956	Total 1957
Allegheny	1	58	65
Appalachian	1	58	26
Central Rocky Mountain	0	32	21
Central States	1	42	12
Columbia River	1	77	54
Gulf States	10	79	53
Inland Empire	1	32	17
Intermountain	0	35	6
Kentucky-Tennessee	1	12	7
New England	2	61	41
New York	0	45	35
Northern California	0	67	19
Northern Rocky Mountain	1	31	49
Ozark	3	19	66
Puget Sound	0	44	50
Southeastern	3	92	111
Southern California	0	2	3
Southwestern	1	2	7
Upper-Mississippi	0	72	49
Washington	0	1	10
Wisconsin-Michigan	1	102	35
Totals	27	963	736

[1]Students, Junior, Affiliate, Associate (Initial) grades only.

COMPLETE INVENTORY CRUISING SCALE



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9:30—17. Exclusion and eradication versus reduction in diseases and pests—M. R. Clarkson, ARS, U. S. Department of Agriculture, Washington, D. C.

10:00—18. Education in the use of chemicals—E. H. Fisher, The University of Wisconsin, Madison, Wis.

10:30—19. Effects of control measures on health and nutrition—Bernard L. Oser, Food Research Laboratories, Inc., Long Island City, N. Y.

11:00— Questions and discussion.

Volunteer papers pertinent to the program theme.

Red Room, Murat Temple, December 30, 2:00 p.m.

Washington, D. C. Section Extends Welcome

The welcome mat of the Washington Section is out for another season of monthly dinner meetings, and all members visiting the nation's capital between September and May are urged to make this group their Society home away from home. Excellent speakers are lined up to bring to members and their wives interesting topics of timely value to foresters as they assume increasing responsibilities as professional people and as citizens, according to C. B. Webster, chairman.

The first meeting scheduled Dr. Marion Clawson of Resources for the Future on September 26, followed on October 24 by Ralph Johnson of the National Association of Home Builders. The discussion on December 5 will be led by Assistant Secretary of Agriculture Ervin L. Peterson at the combined November and December meeting. The monthly schedule then will be resumed as follows: Jan. 16, Feb. 13, March 13, April 17 and May 15. Among the speakers will be Sen. Barry M. Goldwater (R. Ariz.), Rep. Clair Engle (D. Calif.), Mortimer J. Doyle, National Lumber Manufacturers Association, and others to be announced later.

When you arrive in Washington you may make your reservation as late as 11:00 a.m., the day before the meeting by calling the office of the Society,

NAtional 8-1584, or it may be made in advance. The dinner price is $2.25 per person, the regular time is 6:30 p.m., and the place is the YWCA at 17th and K streets, N.W. Remember all members of the Society of American Foresters and their wives are cordially welcomed.

Continuing Evaluation Committee for Forestry Handbook

At the request of The Ronald Press Co., publishers of the *Forestry Handbook*, the Society has undertaken a plan for continual checking and periodic revision of the handbook with a view to keeping the material presented as up to date as possible.

A two-man team for each of the 19 subject divisions covered in the book has been appointed to keep the Society staff advised of changes necessary as they become apparent. Minor corrections or changes will be made on the occasion of reprintings; major changes found necessary will be made in revised editions, published at intervals determined by the publisher. The handbook was first released in September 1955.

Members of the Committee for Continuing Evaluation of the *Forestry Handbook* are:

Forest Measurements. Bert Lexen, Forest Service, Washington, D. C.; J. C. Sammi, College of Forestry, State University of New York, Syracuse, N. Y.

Forest Management. Eric A. Bourdo, Jr., Ford Forestry Center, L'Anse, Mich.; L. R. Grosenbaugh, Southern Forest Experiment Station, New Orleans, La.

Geology. Earl L. Stone, New York State College of Agriculture, Cornell University, Ithaca, N. Y.; S. A. Wilde, University of Wisconsin, Madison, Wis.

Silvics and Silviculture. R. K. LeBarron, California Forest & Range Experiment Station, Berkeley, Calif.; T. E. Maki, School of Forestry, North Carolina State College, Raleigh.

Fire. Jack S. Barrows, Forest Fire Laboratory, Forest Service, Missoula, Mont.; Lawrence F. Cook, National Park Service, Washington, D. C.

Diseases and Insects. John R. Hansbrough, Division of Forest Disease Research, Forest Service, Washington, D. C.; Joseph S. Yuill, Forest Insect Laboratory, Agricultural Research Center, Beltsville, Md.

Wildlife Management. Ralph R. Hill, Denver, Colo.; Lansing Parker, Fish & Wildlife Service, Washington, D. C.

Watershed Management. George W. Craddock, Intermountain Forest & Range Experiment Station, Ogden, Utah; Howard W. Lull, Northeastern Forest Experiment Station, Upper Darby, Pa.

Range Management. Joe A. Wagner, Falls Church, Va.; Clinton Wasser, College of Forestry and Range Management, Colorado State University, Fort Collins, Colo.

Recreation. Frank Childs, National Park Service, Omaha, Nebr.; James H. Tyndall, Forest Preserve District of Cook County, River Forest, Ill.

Materials. Rex E. Melton, Standing Stane Experimental Forest, Huntingdon, Pa.; Henry M. Shank, Forest Service, Denver, Colo.

Utilization. Claude C. Bell, Forest Products Laboratory, Madison, Wis.; W. I. West, School of Forestry, Oregon State College, Corvallis, Ore.

Economics and Finance. G. Robinson Gregory, School of Natural Resources, University of Michigan, Ann Arbor, Mich.; H. R. Josephson, Forest Service, Washington, D. C.

Logging. Frederick C. Simmons, Northeastern Forest Experiment Station, Upper Darby, Pa.; second member to be named.

Surveying and Engineering. Anthony P. Dean, Forest Service, Washington, D. C.

Aerial Photography. John Carow, School of Natural Resources, University of Michigan, Ann Arbor, Mich.; Richard C. Wilson, Forest Service, Washington, D. C.

Communications. Arthur W. Nelson, Jr., Champion Paper & Fibre Company, Pasadena, Texas; Elmer L. Surdam, Forest Industries Radio Communications, Eugene, Ore.

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Chemistry and Physics. Irving H. Isenberg, Institute of Paper Chemistry, Appleton, Wis.; Edwin C. Jahn, College of Forestry, State University of New York, Syracuse, N. Y.

Mathematics. Roy A. Chapman, Forest Service, Washington, D. C.; Howard H. Morgan, U. S. Tariff Commission, Washington, D. C.

Membership Applications and Advancements

Proposals for admission, advancement, and reinstatements received in the Society office during the month of September are listed below.

Action on the eligibility of those proposed for membership as listed below will be taken by the Council as of December 1957. Communications from voting members regarding the membership eligibility of these persons should be received in the Society office prior to that date.

Allegheny Section

Student Grade

PENNSYLVANIA STATE UNIVERSITY

Boyer, R. G.

Junior Grade

Student Eligible for Automatic Advancement

PENNSYLVANIA STATE UNIVERSITY

Upp, D. A.

Appalachian Section

Member Grade

Harris, H. G., Service Forester, N. C. Dept. of Cons. & Dev., Rocky Mount, N. C.; N. C. State, B.S.F., 1952. (Junior 1952).

Affiliate Grade

Smith, A. T., Wood Dealer, Self Employed, Georgetown, S. C.

Central States Section

Junior Grade

Ward, R. D., Farm Forester, Ohio Div. of Forestry, New Philadelphia, Ohio; State Univ. of N.Y., B.S.F., 1956.

Member Grade

Truettner, K. L., Forester, Champion Paper & Fibre Co., Hamilton, Ohio. (Junior 1948).

Columbia River Section

Junior Grade

Pope, C. L., Forester, Hult Lbr. Co., Horton, Ore.; Purdue, B.S.F., 1946; Univ. of Mich., M. F., 1947.

Member Grade

Larson, J. E., Util. Inspector, Weyerhaeuser Tbr. Co., Allegany, Ore.; Ore. State, B.S.F., 1953. (Junior 1953).

Gulf States Section

Student Grade

LOUISIANA POLYTECHNIC INSTITUTE

Bishop, J. E.	Mercer, W. D.
Bryant, J. M.	Neill, B. J.
Carlock, G. M.	Poland, B. C.
Hutchins, J. E.	Powell, C. E.
Jordan, M. L.	Wells, G. R.

Member Grade

Tissue, O. C., Dist. Forester, Miss. Forestry Comm., Philadelphia, Miss.; Pa. State, B.S.F., 1951; N. C. State, M.F., 1953. (Junior 1951).

Affiliate Grade

Edens, R. F., Forester, Edens-Birch Lbr. Co., Corrigan, Texas. (Reinstatement).

Inland Empire Section

Junior Grade

Engwer, J. C., Consulting Forester, Self Employed, Coeur d'Alene, Idaho; Univ. of Idaho, B.S.F., 1951.

Kentucky-Tennessee Section

Junior Grade

Colberg, R. E., Forestry Asst., Hiwassee

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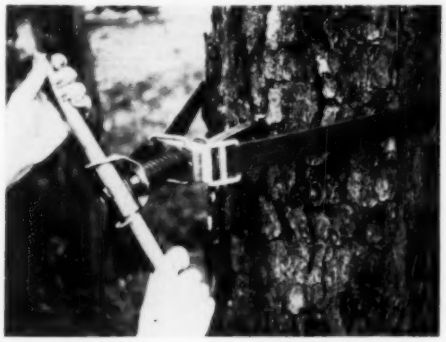

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Land Co., Calhoun, Tenn.; Mich. College of Mining & Tech., B.S.F., 1956. (Junior 1956).

Member Grade

Hamm, M. F., Asst. Dist. Forester, Tenn. Div. of Forestry, Dickson, Tenn.; LSU, B.S.F., 1954. (Junior 1954).

Wardner, A. B., Forester, TVA, Chattanooga, Tenn.; Univ. of Mich. B.S.F., 1953. (Junior 1953).

New England Section

Student Grade

UNIVERSITY OF MASSACHUSETTS

Connor, J. J. Guarnaccia, D.

Member Grade

Bradford, R. F., Forester, Oxford Paper Co., Rumford, Maine; Univ. of Maine, B.S.F., 1951. (Junior 1953).

New York Section

Junior Grade

Student Eligible for Automatic Advancement

STATE UNIVERSITY OF NEW YORK

McLaughlin, W. E.

Northern Rocky Mountain Section

Junior Grade

Eakland, J. W., Junior Forester, USFS, Troy, Mont.; Mont. State, B.S.F., 1957.

Ozark Section

Junior Grade

Bailey, J. A., Field Asst., International Paper Co., Malvern, Ark.; LSU, B.S.F., 1950.

Affiliate Grade

Arnold, W. T., Forest Tech., International Paper Co., Malvern, Ark.
Dix, T. Q., Forester, USFS, Jasper, Ark.

Southeastern Section

Student Grade

UNIVERSITY OF FLORIDA

Folsom, R. L.

Junior Grade

Redmond, H. R., Game Mgmt. Forester, Gulf States Paper Corp., Tuscaloosa, Ala.; LSU, B.S.B., 1948, M.S. (Forestry & Wildlife), 1949.
Cole, R. S., Reforestation Asst., Ga. Forestry Comm., Lyons, Ga. (Reinstatement).
Williams, C. E., Land Acquisition Forester, Gair Woodlands Corp., Savannah, Ga. (Reinstatement).

Students Eligible for Automatic Advancement

UNIVERSITY OF FLORIDA

Watson, H. L.

UNIVERSITY OF GEORGIA

Blackledge, W. H. Hadaway, P. L.
Graham, J. P. Herndon, T. H.

Member Grade

Titus, R. U., Farm Forester at Large, Florida Forest Service, Lakeland, Fla. (Reinstatement).

Affiliate Grade

Dailey, D. M., Forester, USFS, Lake City, Fla.

Southwestern Section

Member Grade

Stevens, C. W., Capt., U. S. Air Force, Goodyear, Ariz. (Reinstatement).

Affiliate Grade

Bearden, E., Forester, USFS, Coyote, N. Mex.

Upper-Mississippi Valley Section

Junior Grade

Student Eligible for Automatic Advancement

Ferree, M. E.

Member Grade

Eggen, C. T., Asst. Area Forester, Bureau of Indian Affirs, Minneapolis, Minn.; Univ. of Minn., B.S.F., 1940.

Washington Section

Member Grade

Lemmon, P. E., Soil Scientist (Forestry), USDA, Beltsville, Md. (Reinstatement).

Wisconsin-Michigan Section

Junior Grade

Smith, A. E., Leader, P-R Forest Habotat Dev. Proj., Wis. Cons. Dept., Woodruff, Wis., Univ. of Mich. B.S.F., 1949, M.F., 1950.
Elliott, K. M., Forester, USFS, Rhinelander, Wis. (Affiliate 1953).

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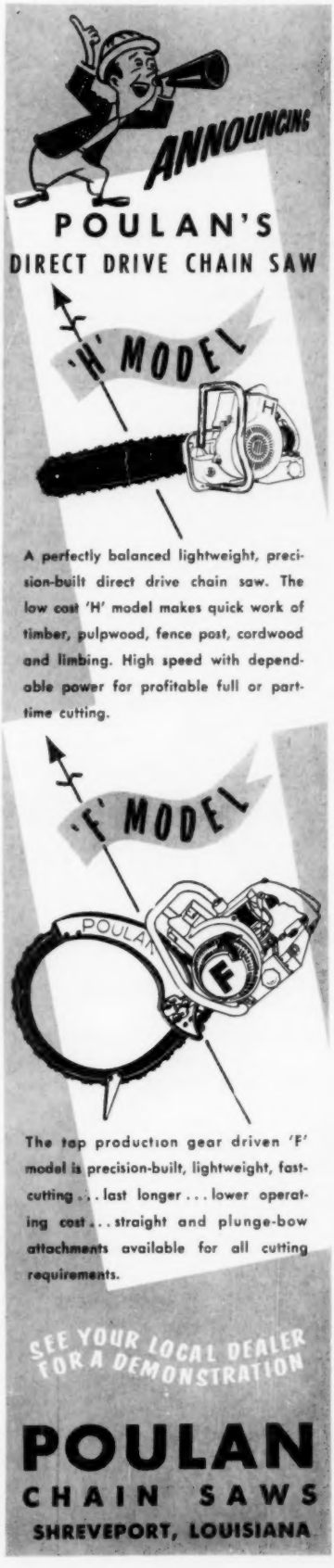
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Forestry News

Conservationists Honored by AFA

Five persons were honored with Distinguished Service Awards by the American Forestry Association at the 82nd annual meeting of that association, held Sept. 30—Oct. 2 in Madison, Wis. Of the five, one is a fellow of the SAF and two are honorary members.

David T. Mason of Portland, Ore., who has been a fellow of the SAF since 1948, was awarded the Distinguished Service Award in the field of business and industry. Mr. Mason, founder of the consulting firm of Mason, Bruce and Girard, was honored for his many contributions to forest management practices.

Tom Wallace, editor emeritus of the *Louisville Times*, Louisville, Ky., was the recipient of the Distinguished Service Award for conservation in the field of public information. As a journalist, he is nationally known for his dedication to the wise use of natural resources.

Frank B. Hubachek, a Chicago lawyer, received the award in the field of general service for his numerous contributions to conservation in the Lake States region, with special reference to development of the Quetico-Superior wilderness program.

Both Mr. Wallace and Mr. Hubachek are honorary members of the SAF.

Conrad L. Wirth, director of the National Park Service, received the award in the field of public servants. In the field of education, Traul G. Walters, Georgia supervisor of agricultural education, Atlanta, was honored for his work with southern youth in wise land use.

Association Executives Meet

The Council of Forestry Association Executives, representing state, regional, and national forestry associations, met September 27-29 at Eagle River, Wis. Host to the meeting was M. N. Taylor, executive director, Trees for Tomorrow, Inc., Merrill, Wis. The meeting agenda included a detailed discussion of the programs of Trees for Tomorrow and general discussion and exchange of ideas among the association representatives present.

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Business Cards, Announcements, Menus

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Christmas Tree Standards Announced

The *Federal Register*, October 1, 1957, published newly adopted standards of the Department of Agriculture for the grading of Christmas Trees. The standards provide for three grades: U.S. Premium, U.S. No. 1, and U.S. No. 2.

These standards, issued for the first time, were to become effective November 1.

Plans Develop for World Forestry Conference

Developing plans for the Fifth World Forestry Congress (see JOURNAL for August, page 574) are indicated by a September announcement of the State Department that the Congress will be held at the University of Washington in the late summer of 1960. The site of the world-wide meeting of foresters was announced by the Department after it had accepted the invitation of Dr. Henry Schmitz, president of the University, past president and Fellow of the SAF, to use the facilities of its Seattle campus.

An offer by the United States to act as host to the Congress was accepted in June by its sponsor, the United Nations Food and Agriculture Organization. At the meeting of the Council of the Society in October 1956, unanimous support to this invitation was given. Preliminary plans for participation by the SAF are now underway by its Committee on International Relations, of which V. L. Harper, assistant chief of the U. S. Forest Service is chairman. The Society will have representatives on the various arrangement committees.

Further news of plans for the Congress will be carried by the JOURNAL as it becomes available.

Key Deer National Wildlife Refuge Authorized

Many years of effort were climaxed during the last session of Congress by the signing into law of an act authorizing the establishment of the Key Deer National Wildlife Refuge to protect the diminutive Florida Key deer and other animals of that unique semitropical area. The law gives the U. S. Fish and Wildlife Service the authority to acquire up to 1,000 acres for refuge purposes by purchase, donation, or exchange.

Wildlife authorities had been urging the establishment of a refuge as the best means of assuring the preservation of a reasonable number of the small Key deer. It is expected that the refuge will be comprised of acreage on several adjacent islands within the range of the deer in order to satisfy the animals' need for varying types of habitat.

Mattison New President of Education Group

Charles W. Mattison, of the U. S. Forest Service information and education office in Washington, D. C., was elected president of the Conservation Education Association at the national group's August 25-28 meeting at Higgins Lake.

Some 120 educators attended the annual meeting at the Michigan Conservation Department's training school and discussed "development of leadership in conservation education."

Other officers elected by the association included Edward M. Ray of the Michigan Conservation Department, first vice president; Dr. Stanley Muliak, University of Utah, second vice president; and Dr. Wilson Clark, Eastern Montana College of Education, secretary.

Mattison, as the Association's new president, replaces Dr. Howard Michaud, Purdue University.

Gain in Pulpwood Use Reported in Central States

Pulpwood production in the Central States gained 31 percent last year over 1955, according to results of a survey just completed by the Central States Forest Experiment Station.

Pulpwood output in the six-state region reached 272,000 cords in 1956. Most of the increase was due to additional consumption by existing plants, the report said.

Soil Bank Conservation Reserve Changes for 1958 Announced

Among other changes, increased annual payments for land planted to forest trees, where such can be justified by county Agricultural Stabilization and Conservation Committees, is provided in the 1958 Conservation Reserve program. While the 10-year minimum contract will still apply to tree planting for forestry purposes, farmers may also enter 50-year contracts for land devoted to trees for shelterbelt, windbreak, or wildlife habitat purposes.

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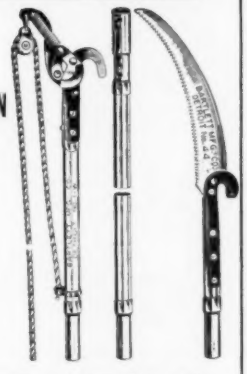

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Rhode Island —the dark-green state

Rhode Island's official title is "State of Rhode Island and Providence Plantations" and this makes it the largest name.

Although it is the smallest state in the Union, Rhode Island is the most densely populated per unit of area. However, two-thirds of the State is in woodland.

It's terrain stretches from sea level to gently rolling hills in the west with a soil that is well drained and best adapted to eastern white pine.

At one time its majestic forests were frequented by the King's officials who blazed an arrow on the tallest and straightest white pine trees. These "King's" pine or "Arrow" pine were selected to serve as masts for the ships of the Royal Navy. Anyone caught damaging these trees was hanged.

With the passing of sailing ships and current demand for lumber, plus hurricanes, ice storms and forest fires, the "Arrow" pines have dwindled in number and size. However, the soil has remained and with this vital foundation, a comeback is being made toward the re-establishment of Rhode Island woodlands to the dignity and stature they once enjoyed.

Through the various mediums of education such as Service Forestry, State Forest Nursery, Cooperative attempts toward Fire Prevention and Suppression, with private and public owners and agencies, the end result looks promising. Forestry is not a lost science in Rhode Island and its status in the State's economic cycle will soon be felt to a larger degree.

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Private & Industrial

Georgia-Pacific Corporation Names New Director of Research

Officials of the Georgia-Pacific Corp. in Portland, Ore. recently announced the appointment of Dr. Robert W. Hess as director of research.

Prior to joining the Georgia-Pacific staff, Dr. Hess was affiliated with the Mengel Co., Laurel, Miss. He is a former associate professor of forestry at Yale University.

Wolcott Named Forester for Inland Container Corp.

Inland Container Corporation has announced the August 1 appointment of Roger W. Wolcott as mill division forester with headquarters at Rome, Ga. He will be concerned with wood procurement, land management, and woodland practices.

Prior to joining the Inland organization Wolcott was area forest superintendent for International Paper Co. at Raleigh, N. C.

He has served as president of the North Carolina Forestry Association since 1950.

International Paper Establishes New Research Center

Dr. Charles H. Driver has been appointed director of forest research at International Paper Company's new Southlands Experiment Forest located near Bainbridge, Ga., it has been announced by Erling Riis, vice-president of International Paper Company and general manager of the Southern Kraft Division. He has been employed in the Research Department of the Southern Kraft Division of International Paper Company in Mobile for the past three years.

The Southlands Experiment Forest is International's first forestry research center to be established in the South, although the company has operated similar installations for some years in its Northern and Canadian divisions.

Milliken Forestry Co. Enlarges Staff

William F. Milliken announces that the staff of the Milliken Forestry Co., consulting foresters, has been increased by the addition of Monroe Greene. Mr. Greene was previously with Seibels Bruce Insurance Co. where he developed a forest fire insurance program. He holds an M.S. degree in forestry from the University of Georgia.

An earlier addition to the staff of the company is Kenneth M. Allen, who had previously been with the Forest Service, the SCS, and the West Virginia Pulp and Paper Co.

Forestry Association Promotes Pittman

Frank B. Pittman, of Jackson, has been promoted to the position of executive vice-president of the Mississippi Forestry Association, according to an announcement by R. C. Allen, president.

Pittman has served the Association as executive secretary for the past 19 years. He has helped to develop such programs as Boys Conservation Schools, Keep Mississippi Green, and Tree Farming. Mississippi has become the leading state in the nation in the number of certified tree farms.

The vacancy created in the position of executive secretary will be filled by Ben A. Davis, Jr., of Jackson, who has served since January 1956 as assistant executive secretary.

Harold W. Hicks Joins Southern Consulting Firm

Harold W. Hicks has joined the Southern Timber Management Service of Birmingham, Ala. upon his retirement from government work June 30.

For 32 of his 35 years with the government Mr. Hicks was employed as a forester with the Fish & Wildlife Service, the Forest Service, the Soil Conservation Service, and Corps of Engineers. At the time of his retirement he was district forester with the Corps of Engineers in Mobile, Ala.

He holds forestry degrees from Montana State University and Yale University.

Attends Commonwealth Forestry Conference

Charles D. Schultz, president, C. D. Schultz & Co. Ltd., Vancouver engineering and forestry consultants, at-

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tended the Seventh British Commonwealth Forestry Conference, held in Adelaide, Australia on August 26th.

Mr. Schultz, who is a director of the Canadian Forestry Association, traveled as an official delegate of that body, and read to the Conference a statement of policy of the Association.

The Conference, which is held every four years and last took place in Canada in 1953, dealt with all phases of forestry and forest production, and was attended by some 100 delegates from every part of the Commonwealth including seven from Canada.

North Carolina Forestry Association Has New President

Members of the North Carolina Forestry Association have elected O. J. Blades new Association president. He succeeds Roger W. Wolcott.

Mr. Blades is chief forester for Duke Power Co., Charlotte, N. C. Mr. Wolcott, formerly with International Paper Co., recently accepted a position with Inland Container Corp. in Rome, Ga.

Education

New Forest Insect Lab Ready at Oregon State College

A new $35,000 forest insect laboratory has been completed at Oregon State College for research on forest pests.

Testing of insecticides to determine which are most effective and practical to use against various insects will be the major phase of work. Tied in with the testing will be the basic research on insect biology, behavior, and activities. Dr. Julius Rudinsky is project leader.

Entomologists of the Oregon state board of forestry are cooperating in the research.

The insect project is sponsored by the Northwest Forest Pest Action Council, the Oregon State Board of Forestry, and the Pacific Northwest Forest and Range Experiment Station, Portland, in cooperation with the college. A grant of $3,800 also was received last month from the Foundation for American Resource Management, San Francisco, to help support the research.

Zivnuska to Study Timber Status in Far East

John A. Zivnuska, associate professor of forestry at the University of

California, left early in September for a three months assignment with the Economic Commission for Asia and the Far East, a branch of the United Nations.

He will serve is a member of the study group working on the Far East Timber Trends study. This study is concerned with timber requirements, resource development, and industrial priorities for the forests of the Far Eastern nations.

Dr. Zivnuska's previous experience with studies of this type includes the Stanford Research Institute study, "America's Demand for Wood," and his recent analysis of the Timber Resource Review, "Timber Today—And Tomorrow." His headquarters on the Far Eastern study will be in Bangkok, Thailand.

Hungarian Forest Engineer Dies

According to information received by the immigrant Hungarian Forestry Faculty affiliated with the University of British Columbia, Dr. Géza Lunez, distinguished Hungarian forest engineer, is dead.

He was formerly a member of the F.A.O. secretariat in Rome, had been with the C.I.S. (International Forestry Association) in Berlin, and was on the staff of the Hungarian Scientific Forest Research Institute in Budapest.

Michigan Professor Retires

Earl C. O'Roke, professor of forest zoology and secretary to the faculty of the School of Natural Resources, University of Michigan, has retired after 28 years at the University.

Born in Sabetha, Kan., Professor O'Roke attended the University of Kansas where he received his B.A. and M.A. degrees in 1912 and 1916 respectively. From 1927 to 1929 he served as an assistant at the University of California and received his Ph.D. from there in 1929.

In autumn of that year he joined the staff of the University of Michigan, was promoted to associate professor in 1937 and to full professor in 1955.

He is a member of Sigma Xi and is a Fellow in the American Association for the Advancement of Science.

H. G. Wilm Heads International Association

Dr. Harold G. Wilm, associate dean of the State University College of Forestry at Syracuse University, Syracuse, N. Y., was elected president of the International Association of Scientific Hydrology at the Triennial Convention of the International Union

HAROLD G. WILM

of Geodesy and Geophysics, which met recently (Sept.) in Toronto.

Dr. Wilm is the only American elected to hold office in the international organization for research scientists and engineers. He will serve a three-year term as president.

The Association of Scientific Hydrology is concerned with the movement of water over and within the earth—from its precipitation as rain or snow until it reaches the oceans. For that reason, the Association's membership is composed, almost exclusively, of physical scientists and engineers.

St. Regis Announces Scholarship Winners

St. Regis Paper Company announces the award of five undergraduate scholarships in forestry as part of its scholarship program for the academic year 1957-58. The five winners of last year's scholarship awards are continuing in their senior years and the second years of their scholarships.

Three undergraduate scholarships are awarded in the South, and one each in the Northwest and Northeast. The scholarships in the South are provided, one each, at Alabama Polytechnic Institute, the University of Florida, and the University of Georgia. Each amounts to $800 a year for a two year period, and is awarded to an

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The winners of the southern scholarships are: Harvey H. Johnson of Albany, Ga., attending the University of Georgia; Paul D. Kidd of Gainesville, Fla., attending the University of Florida; and James R. Lowe of Lafayette, Ala., attending Alabama Polytechnic Institute.

The scholarship winner in the Northwest is Jerry Forest Franklin of Camas, Wash. He is attending Oregon State College.

C. Anthony Federer, of Belmont, Mass. is the scholarship winner in the Northeast. He is attending the University of Massachusetts.

"Mando" Research Fellowship Winner Announced

Neil Paulson, 1957 forestry graduate of the Michigan College of Mining and Technology, Houghton, Mich., has been awarded the Minnesota and Ontario Paper Company Graduate Research Fellowship in the Minnesota School of Forestry. This announcement was made jointly by F. H. Kaufert, director of the school of forestry, and George Amidon, Mando's director of woodlands.

Public

Forest Economist Promoted

Promotion of Floyd L. Moravets to chief of forest economics research at the Pacific Northwest Forest and Range Experiment Station has been announced by R. W. Cowlin, director. Appointment of Moravets, who has been assistant chief of the division, fills the vacancy created earlier this year by the death of Martin E. Baudendistel.

In his new position, Moravets will be responsible for economic studies and the regional phase of the nationwide Forest Survey.

For 32 of the past 35 years, Moravets has been employed in the Pacific Northwest region of the Forest Service. Since 1946 he has specialized in analysis of survey data and results of economic studies relating to forest resources and their utilization.

Moravets' work in interpretation of data and in dissemination of forest resource information to private landowners, forest industries, and public agencies in the Pacific Northwest earned him a meritorious award for superior accomplishment from the Chief of the Forest Service in 1953.

Seed Program to be Established in Wisconsin

A certified seed program for trees that is comparable to seed programs for grain, forages, and potatoes will be put into action cooperatively by the Wisconsin Conservation Department and the University of Wisconsin to assure that foresters can get seed from superior trees to use in future reforestation programs.

Specialists R. G. Hitt, R. R. Hartig, and R. A. Brink are planning the program concurrent with their research on forest tree breeding. The program might require setting up supervision standards for getting seed from private parties throughout the Lake States.

Stoltenberg Chief of Northeastern Forest Economics Research

Carl H. Stoltenberg has been appointed chief of the Division of Forest Economics Research at the Northeastern Forest Experiment Station, Forest Service, U. S. Department of Agriculture.

His appointment was announced by Dr. Ralph W. Marquis, director of the station. Dr. Stoltenberg succeeds John R. McGuire, who left the station to become chief of the Division of Forest Economics Research at the California Forest and Range Experiment Station, Berkeley.

Dr. Stoltenberg joined the Experiment Station staff in June 1956. Formerly he had been assistant professor of forest economics at the School of Forestry, Duke University. He at-

tended the University of California at Berkeley and received his Ph.D. Degree at the University of Minnesota in 1952.

McNasser Heads Southeastern Fire Research

Karl W. McNasser, formerly of the Division of State and Private Forestry with the U. S. Forest Service in Atlanta, is heading newly expanded work in forest fire research at the Southeastern Forest Experiment Station.

McNasser's appointment closely follows a recent major increase in fire research funds for the Southeast. Among other projects, the expansion means a new research center that is being established at the Georgia Forestry Commission offices in Dry Branch, Ga. Jointly financed by the Georgia Research Council, the Georgia Forestry Commission, and the U. S. Forest Service, the greatly enlarged research program aimed at devising ways to cut down forest fire losses will be under McNasser's direct supervision.

C. F. Burnham to Station Management Post

Chester F. Burnham has been appointed chief of the Division of Station Management at the Southern Forest Experiment Station, New Orleans. He will be responsible for coordinating the Station's administrative work in the eight states of the Midsouth.

Previously Burnham was in the regional office of the U. S. Forest Service in Atlanta, Ga. From 1951 to 1956 he was supervisor of the Alabama National Forests.

CHESTER F. BURNHAM

New Supervisor Named for Fremont

Clayton H. Weaver has been named supervisor of the Fremont National Forest, Lakeview, Ore. He replaced John E. McDonald who resigned to accept private employment, according to joint announcements by Regional Forester J. Herbert Stone and Samuel Feldman, president of Lakeview Lumber Products Co. McDonald left the Forest Service in September for his new position. Weaver will assume supervisorship in Lakeview about the middle of October.

Weaver has been on the staff of the Eldorado National Forest, Placerville, Calif., for the past 2½ years in charge of fire control, lands, range, wildlife, and training activities. In January 1957 he received a Superior Service Award from the Department of Agriculture in recognition of exceptional achievement and outstanding leadership in resource management and protection on the Eldorado.

McDonald, who will become forester and assistant manager of the Lakeview Lumber Products Company, has been supervisor of the Fremont National Forest since 1950.

Personnel Changes in Rocky Mountain Region

E. J. Fortenberry, Medicine Bow National Forest supervisor at Laramie, Wyo., will become head of the Branch of Watershed Management in the U. S. Forest Service Denver Regional Office. George K. Brown, supervisor of the Arapaho National Forest at Golden, Colo., replaced Fortenberry at Laramie; and Henry Tiedemann, head of mining claims examination in the Denver office, succeeded Brown as Arapaho supervisor at Golden.

Regional Forester Donald E. Clark announced these personnel changes in the Rocky Mountain Region of the Forest Service, effective about September 30.

William L. Robb Retires

William Lee Robb, timber management specialist in the North Central Region of the Forest Service, retired on August 1 after 33 years of service. He has been assigned to the regional office at Milwaukee since 1954.

Robb entered the Forest Service in his native state of Pennsylvania in 1924, following his graduation from Penn State University. He soon transferred to the Rocky Mountain Region where he had various assignments on the national forests of Colorado and Wyoming including the positions of forest ranger and forest staff officer. In 1934 he was appointed forest supervisor of the Arapaho National Forest. The following year he moved to the regional office at Denver, Colo. From there he was transferred to the regional office at Ogden, Utah in 1939. His final move was in 1954 to Milwaukee.

D. S. Nordwall to Washington Post

David S. Nordwall, Operation and Personnel Management division head in the U. S. Forest Service Denver

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Caterpillar Tractor Co.	Third Cover
Clark, Thomas G.	877
Clifton, Thomas C.	878
Crank, Porcius F., Jr.	878
Cranston, Keith	876
Eastman, Wm. A., Jr.	878
Fechheimer Bros. Co.	865
Forest Seeds of California	864
Forestry Suppliers, Inc.	869
Guthrie, John G.	879
Hale Fire Pump Co.	862
Hall, Albert G.	878
Hammon, Jensen & Wallen	876
Homelite Corporation	Back Cover
Keene Forestry Association	865
Knoth, Robert F. & Co.	877
Koppers Company, Inc.	861
Kurfew, Inc.	866
Lemieux, Frank J.	879
Lind, A. L. Company	865
Lowther, Harry A. Co.	864
Lufkin Rule Co.	868
McCurdy Bros. Nurseries	864
Meadows, Ben	868
Musser Forests, Inc.	863
National Agr. Supply Co.	867
Nelson Company	871
Northeast Forestry Service	879
Northern Tree Co.	878
Pacific Weather Service	864
Paint Creek Nurseries	864
Panama Pump Company	860
Pomeroy & McGowen	876
Pond & Moyer Co., Inc.	879
Poulan Chain Saws	871
Prentiss & Carlisle	878
Price, Wm. H.	877
Rich, C. H. Forest Fire Tool Co.	865
Rootspred Tree Planter	873
Sanders, Paul M.	877
Sebrell, J. B. Corp.	862
Sewall, James W. Co.	876
Shannon, R. B. & Assoc.	877
Silva, Inc.	864
Smith, D. B.	Second Cover
Southern Coatings	874
Southern Seed Co.	866
Southeastern Waterproofing Co.	875
Stock, John W.	878
Suncrest Evergreen Nurseries	875
Timber Management Service	879
Tree Farm Management Service	879
Utility Tool & Body Co.	865
Western Fire Equipment Co.	872
Weyerhaeuser Timber Co.	870
Winslow, Paul T.	878

Regional Office, has been promoted to head of the Internal Audit Branch in the office of the Chief Forester in Washington, D. C. Prior to his assignment in the Denver Regional Office, he served as supervisor of the Medicine Bow National Forest with headquarters at Laramie, Wyo.

Nordwall's replacement is Ernest M. Karger, previously in charge of Operation, Fire Control, and Personnel Management for the Eastern Region of the Forest Service at Philadelphia. Among other assignments in the Eastern Region of the Forest Service, he served as supervisor of the George Washington National Forest in Virginia.

Spaulding Heads Fire Control in Northwest

Alfred E. Spaulding has assumed the duties of fire control chief in the Pacific Northwest Region of the U. S. Forest Service, according to an announcement by Regional Forester J. Herbert Stone.

Spaulding has been in charge of fire control activities in the Northern Region slightly over six years and before that was forest supervisor of the Colville National Forest in northern Washington and Idaho for five years.

He replaces Kermit W. Linstedt who has become chief of the Regional Division of Soils and Watershed Management of the Forest Service, Portland Ore.

Churchill Moves to Portland Office

George W. Churchill has been promoted from district ranger of the Little River district, Umpqua National Forest, to assistant head of the section of recreation in the Portland Regional Office, Division of Recreation and Lands, Regional Forester J. Herbert Stone has announced.

Study to Appraise Washington's Pulpwood Resources

A survey of Washington's pulpwood potential initiated by the Institute of Forest Products, is progressing under the direction of Dr. Harvey D. Erickson.

Dr. Erickson, who teaches wood products at the College of Forestry, University of Washington, is consulting with each pulp and paper firm in the state regarding the present use of pulpwood and changes which probably will take place in the near future. The objective of the study is to compare the state's pulpwood potential with the present and future demands of industry.

The importance of the investigation is stressed by the fact that paper pulp produced during the past year in Washington State was valued at almost four hundred million dollars, which was one-third more than the value of Washington's lumber which was produced during the same period.

Forestry Employment

S.A.F. members are privileged to insert one 60-word advertisement in this column without charge. Forest industries desiring to employ foresters may insert advertisements at the rate of $4 per column inch. Copy must be received by the end of this month for an advertisement to appear in the issue after next.

Obviously, the Society cannot assume responsibility beyond making it possible for prospective employee and employer to enter into negotiations.

Position Available

Arborist for the City of Richmond, Virginia. Male, age 25 to 50. College graduate in agriculture, horticulture, or forestry plus five years of experience. Salary range $4,992-$5,980. **Apply Department of Personnel, Room 314 City Hall, Richmond 19, Va.**

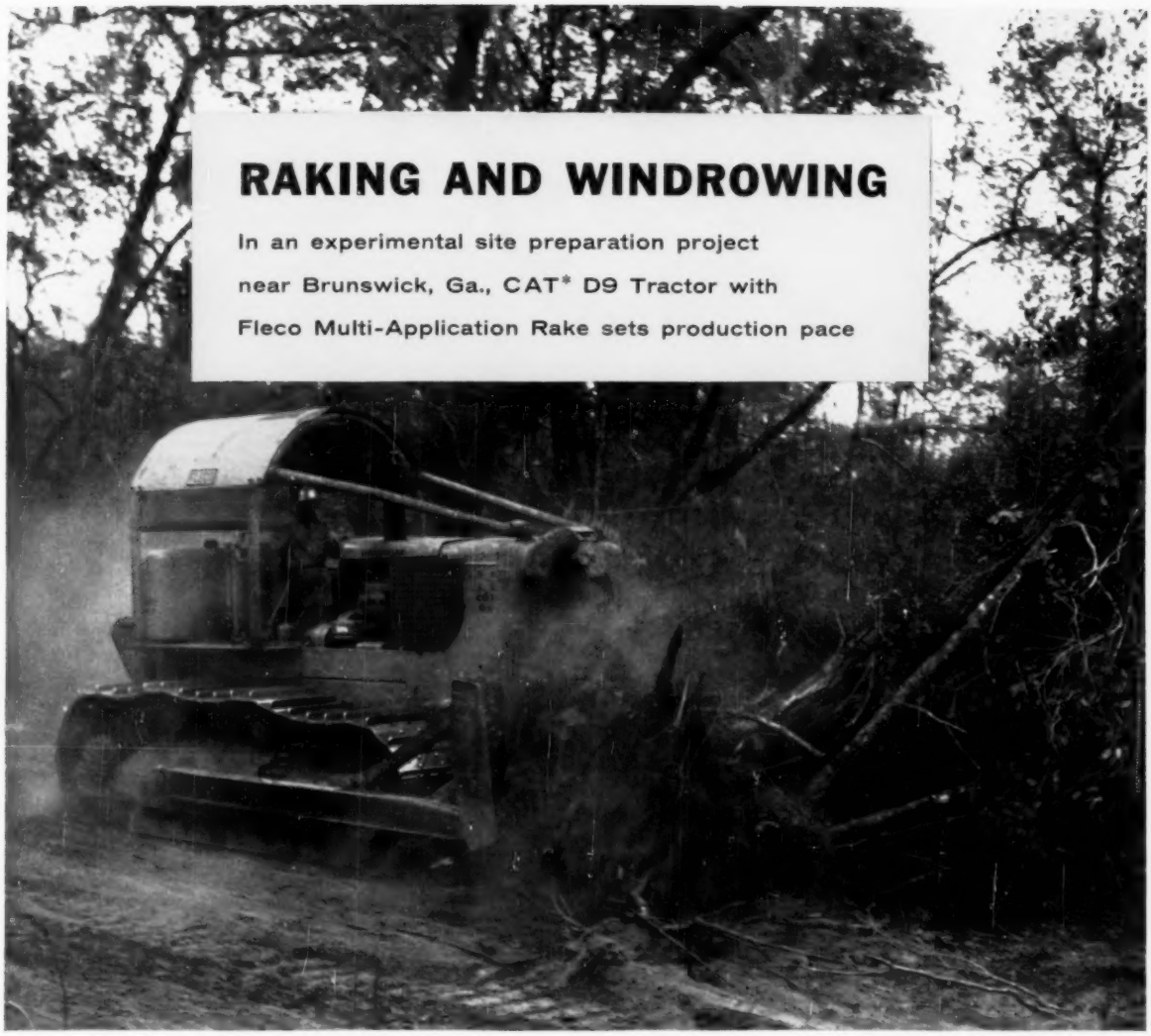
Positions Wanted

Forester, B.S.F., 1950; M.S., 1951. Age 35, married, three children. Eighteen month teaching assistanship in botany—Purdue. Six years in national forest administration, southern Appalachian and southern pine regions. One year as district ranger. Experienced in fire control, silviculture, management, personnel, and public relations. Desires employment teaching forestry. Other forestry positions will be considered.
Box M, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S., Univ. of Maine. M.F. in wood utilization from Yale. Age 27, married. Experience with pulp and paper company in cruising, photogrammetry, chemical debarking, inspection cutting operations, planning and laying out cutting operations, and public relations. Two years experience as a wood technologist for a large utility research laboratory dealing with many different wood products. Desire employment in Northeast or the Lake States.
Box N, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S., N.Y. State University 1952; Photogrammetry Syracuse University 1952. Age 26, single—ex-naval aviator holds commercial aircraft and helicopter rating. 2½ years experience in aerial photography and photogrammetry in Europe, Africa, and Middle East. Logging experience Maine and Washington. Ex corporation president. Desires position in logging or lumber business anywhere in the world, especially South America. Traveling preferred. Excellent references.
Box O, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S.F., married, 2 children. Ten years apprenticeship timber inventory and land surveying on west coast. Desires position with private industry to supplement forestry knowledge or obtain lumber experience. Autobiography on request.
Box P, Journal of Forestry, Mills Building, Washington 6, D. C.



RAKING AND WINDROWING

In an experimental site preparation project near Brunswick, Ga., CAT* D9 Tractor with Fleco Multi-Application Rake sets production pace

To determine the various applications of crawler tractors and land clearing equipment for site preparation, Caterpillar Tractor Co. and the Brunswick Pulp & Paper Co. held a three months' series of field experiments near Brunswick, Ga. One series involved raking and windrowing. The stand chosen for treatment was classified as hammock lands with live oaks up to 72″ in diameter, turkey and water oaks running into heavy palmetto, gall berry, myrtle and vine areas. Merchantable timber had been harvested but no clearing completed. Equipment in this experiment included the D9 shown above, a D8 with Fleco Rock Rake and a D7 and a No. 977 Traxcavator with Fleco Rakes.

Each machine was assigned to a plot. The giant 320 flywheel HP D9 cleared the densest areas, while the D8, D7 and No. 977 handled the less dense and light plots. In these plots, the machines were able to push the accumulated cover 165′ directly to the windrow. Very dense conditions, however, required that the tractor push the vegetation down parallel to the windrow. Operator judgment determined the method used. This technique utilized the rake as the felling, raking and windrowing one-purpose tool.

See your Caterpillar Dealer for complete information on this operation as well as other phases of the experimental studies such as: stump clearing and cutting, chaining, stump treatment and harrowing.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

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7-29 most powerful one-man chain saw you can own. 7 horsepower, 29 pounds. Powerful enough to bring down any tree in a stand. Fells trees up to 10 feet in diameter.

Homelite builds and sells more chain saws than any other company in the world.

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